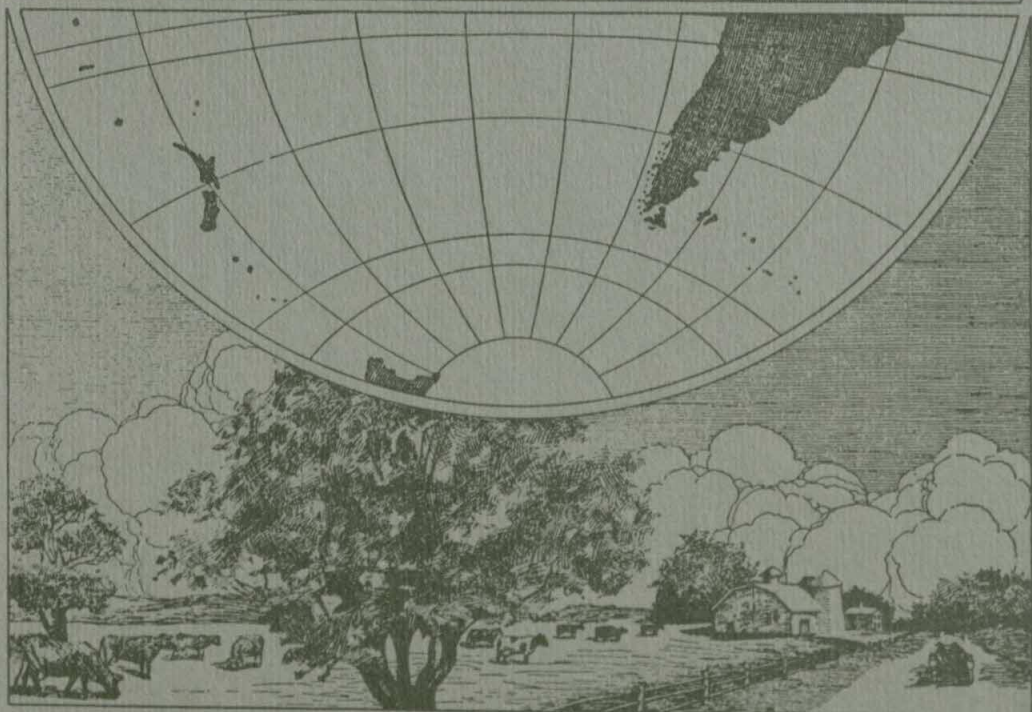
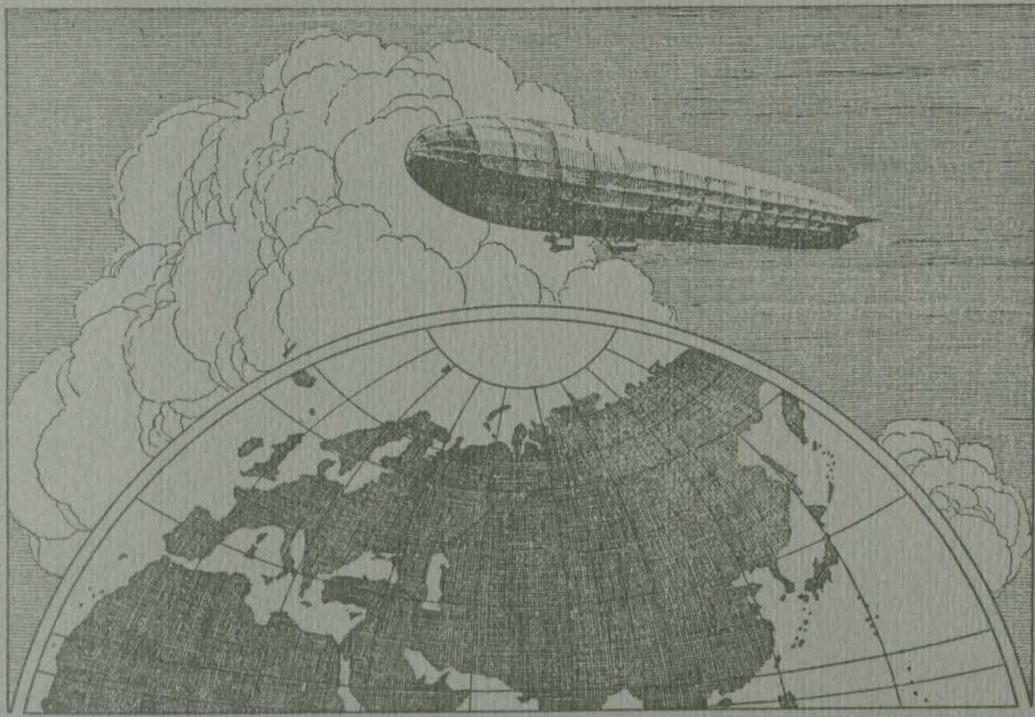


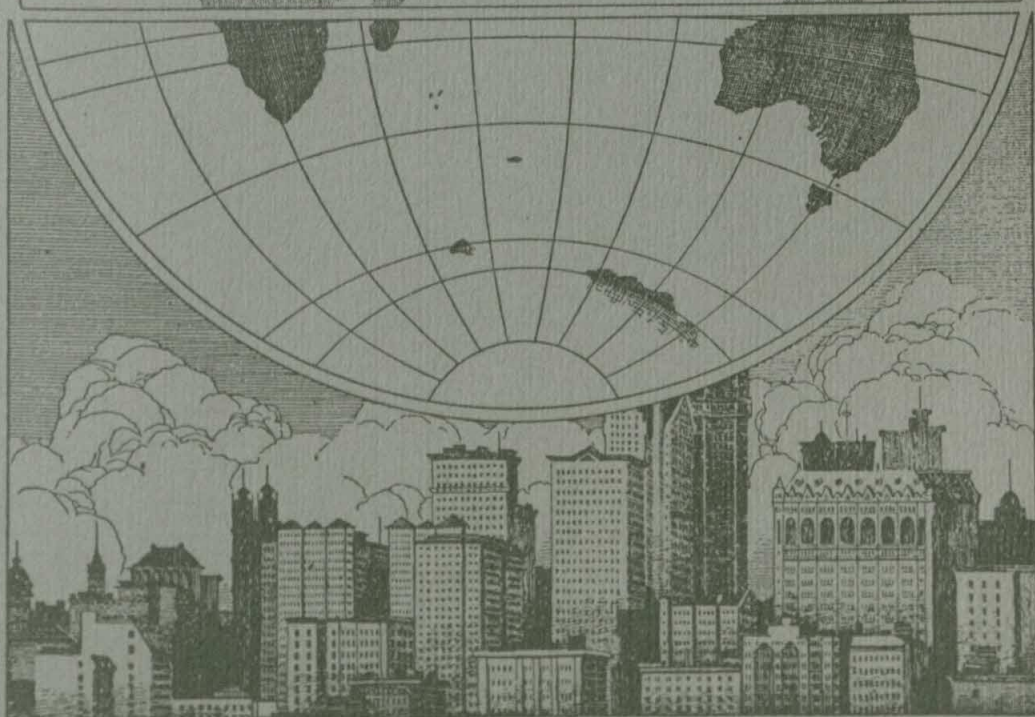
# THE WORLD BOOK







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D Volume 5

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# The World Book Encyclopedia



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## The World Book Encyclopedia (International)

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# Dd

**D** is the fourth letter of the English alphabet. It was also the fourth letter in the alphabet used by the Semites, who once lived in Syria and Palestine. They named it *daleth*, a word that meant *door*. It is believed that this word came from one of the *hieroglyphs* (picture writings) the ancient Egyptians used. They drew a picture of a door with panels. See **Alphabet**.

**Uses.** *D* or *d* ranks as about the tenth most frequently used letter in books, newspapers, and other printed material in English. When used on a report card, *D* usually means poor work or near failure in a school subject. In music, it names one note of the scale. As an abbreviation, *D* stands for the isotope *deuterium* in chemistry, for *electric flux density* in electronics, and for *500* in the

Roman numeral system. The symbol *d* denotes *drag* in aeronautics, and the fourth known quantity in algebra. The symbol *D* or *d* stands for *diameter* in mathematics and physics, or a wider-than-average shoe size in most countries.

**Pronunciation.** In English, a person pronounces *d* with the tongue touching the roof of the mouth just behind the teeth. In French, Dutch, and Italian, the tongue touches the upper front teeth. In German, a *d* at the beginning of a word, followed by a vowel, resembles the English *d* sound. Otherwise, it usually has a *t* sound. The Spanish *d* is expressed more softly than in English when it is at the beginning of a word. Elsewhere, it has a *th* sound, similar to *the* in English, not the *th* of *thin*.

## Development of the letter D



The ancient Egyptians drew this symbol of a door with panels about 3000 B.C. The Semites adapted the symbol and named it *daleth*, their word for *door*.



The Phoenicians used a triangle in their alphabet about 1000 B.C.



The Greeks, about 600 B.C., shaped the letter as an equilateral triangle. They called their letter *delta*.



The Romans rounded the letter and gave it its capital form about A.D. 114.

The small letter *d* developed about A.D. 500 from Roman writing. Monks who copied manuscripts reshaped the letter during the 800's. By about 1500, the letter had developed its present shape.



A.D. 500



1500

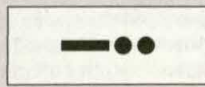


Today

## Special ways of expressing the letter D



International Flag Code



International Morse Code



Braille



American Sign Language

British Sign Language



Semaphore Code

## Common forms of the letter D

Dd *Dd*

**Handwritten letters** vary from person to person. *Manuscript* (printed) letters, left, have simple curves and straight lines. Cursive letters, right, have flowing lines.

Dd *Dd*

**Roman letters** have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears on the right.

Dd *Dd*

**Sans-serif letters** are also called *gothic letters*. They have no serifs. The type face shown above is called Futura. The italic form of Futura appears on the right.

D

**Computer letters** have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.



## 2 D-day

**D-day** is the term for a secret date on which a military operation is to begin. Peacetime planning of military operations is also based on hypothetical D-days. Terms such as *D-plus-3* (three days after initial attack) are used to plan the sequence of operations. The expression *D-day* became current in World War II (1939-1945) when it defined the dates set for Allied landings on enemy-held coasts. The most famous D-day is June 6, 1944, when the Allies invaded Normandy.

See also **World War II** (D-Day).



**D-Day, June 6, 1944**, is the day Allied troops landed on the beaches of Normandy, France, during World War II.

**Da Nang** (pop. 492,194) is one of the largest cities in Vietnam. Da Nang is also called Tourane. The city's location on the South China Sea has made it an important trading centre since the 1600's. For the location of Da Nang, see **Vietnam** (map).

Da Nang became a city of South Vietnam in 1954, when that country was created. Da Nang was a key city during the Vietnam War (1957-1975) because of its location near North Vietnam. United States military forces established bases there and the city became a favourite target of the North Vietnamese forces. The North Vietnamese Communists took control of South Vietnam in 1975. They unified North and South Vietnam into the single nation of Vietnam in 1976.

**Dacca.** See **Dhaka**.

**Dachau** was one of the first concentration camps set up in Germany by the Nazis. It stood near the town of Dachau, 16 kilometres from Munich. Dachau was built in 1933 as an extermination camp for Jews and political prisoners. After 1943, many prisoners worked in arms factories that were built there. The Nazis performed brutal medical experiments on over 3,500 people. Almost all of these prisoners died. Thousands more were executed or died of starvation and epidemics. United States forces liberated about 32,000 prisoners on April 29, 1945.

**Dachsbrake** is a mountain hunting dog. Originally, it was bred in the mountainous regions near the German-Czechoslovak border. The dachsbrake looks like a medium-sized Dachshund but has longer legs. It has an exceptional sense of smell. It is used to hunt hare, fox, deer, and wild boar. There are three types of Dachsbrake. The Westphalian, the smallest (and the rarest), has

a short white coat and stands between 30 and 35 centimetres tall. The Montano-Alpine and the Erz Mountain dogs stand between 34 and 42 centimetres tall. They have short black, brown, or chestnut coats.

**Dachshund** is a dog known for its long, low-slung body and short legs. The breed originated in Germany, where it was trained to hunt badgers. The word *dachshund* is German for *badger hound*. The dachshund has a cone-shaped head, a slim, tapering muzzle, and long, drooping ears. Its front legs are slightly curved. Its



**A dachshund has a long body and short legs.**

glossy coat usually is black or tan, but it may be red, yellow, grey, spotted, or striped. Many dachshunds have short smooth hair. Two other varieties are the long-haired, with long, silky hair; and the wirehaired, with a rough coat. The dachshund makes a good watchdog and a wonderful pet.

See also **Dog** (picture: Hounds).

**Dacia.** See **Tzajan; Rome, Ancient** (map).

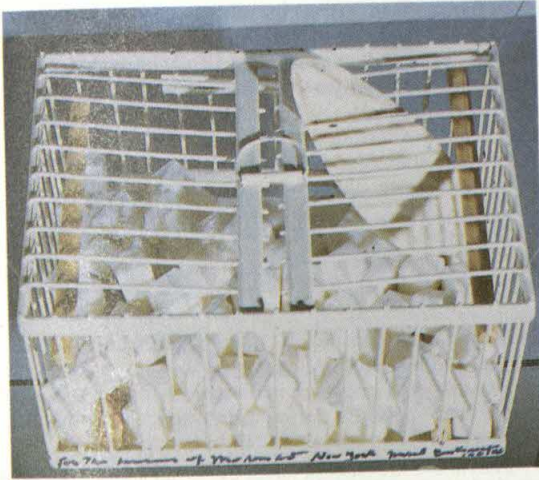
**Dacorum** (pop. 129,200) is a local government district in Hertfordshire, England, on the lower slopes of the Chiltern Hills. Agriculture is important, supplying milk and other fresh produce to the nearby London markets. Other industry is centred on the new town of Hemel Hempstead. Industry there includes printing and publishing, and film processing.

See also **Hertfordshire**.

**Dadaism**, a protest movement in the arts, was formed in 1916 by a group of artists and poets in Zurich, Switzerland. The Dadaists reacted to what they believed were out-of-date concepts in art, and the evils they saw in society. They tried to shock and provoke the public with outrageous pieces of writing, cabaret skits, poetry recitals, and art exhibitions. Much Dada art was playful and highly experimental. The name *Dada*, a French word meaning *hobbyhorse*, was deliberately chosen because it was nonsensical.

The founders of the movement included the French poet Tristan Tzara, the French artist Jean Arp, and the German poet Hugo Ball. Later members included the French artist Francis Picabia, the French poets Louis Aragon and André Breton, and the German artist Max Ernst. Perhaps the best-known Dadaist was the French artist





**A Dada sculpture** by Marcel Duchamp called *Why Not Sneeze Rose Sélavy?* is a painted metal birdcage containing 151 marble blocks, a thermometer, and a piece of cuttlebone.

Marcel Duchamp. He was not a member of the Zurich group, but was working in the Dada spirit as early as 1913. About that year, he completed his first *ready-made*. Ready-mades were common objects, such as bicycle wheels, exhibited as works of art. In this way, Duchamp ridiculed the idea that art was profound.

See also **Arp, Jean; Breton, André; Duchamp, Marcel; Ernst, Max; Painting** (The 1900's: Dadaism).

**Daddy longlegs** is the popular name for a long-legged insect also known as a *crane fly*. It has a slender body and extremely long legs. The adult daddy longlegs is slow flying and is often found among grasses and near water. The female lays eggs that develop into a larva known as a *leather-jacket*. Leatherjackets feed mainly on the roots of plants. Some are pests of cereal crops.

In North America, daddy longlegs refers to completely different long-legged creatures related to spiders that are called *harvestmen*.



**Daddy longlegs**

**Scientific classification:**

Daddy longlegs are insects, order Diptera, family Tipulidae. Harvestmen belong to the class Arachnida, order Opiliones.

See also **Arachnid**.

**Dadra and Nagar Haveli** (pop. 138,542) is one of the union territories of India. It lies near the west coast and consists of two separate parts. Dadra is surrounded by the state of Gujarat, and Nagar Haveli lies on the borders of Maharashtra and Gujarat. The capital is Silvassa. The Union Territory covers 491 square kilometres. Most of the people are Adivasis. The Adivasis are divided into tribal groups such as Varlis, Dublas, Dhodias, and Koknans. The languages spoken in the territory are Bhili, Bhilodi, Gujarati and Hindi.

The northeast and southeast areas of this territory are steeply hilly, whereas the central areas consist of plains. The soil is moist and fertile. Nagar Haveli has large areas of teak forests.

Agriculture is the main occupation of the Adivasis, and they produce rice, ragi, pulses, and fruits. In recent years, plantation schemes and afforestation have increased the amount of timber under construction, creating job opportunities for landless labourers and forest dwellers. There is no large-scale industry.

Dadra and Nagar Haveli became part of the Portuguese-controlled region of India during the 1780's. In 1954, Goan nationalists took over the area, and in 1961, the territory was integrated into the Indian Union.

Dadra and Nagar Haveli is run by an Indian government-appointed administrator, and village affairs are looked after by democratically elected *panchayats* (village assemblies).

**Daedalus**, in Greek mythology, was a skilled Athenian craftsman and inventor. Daedalus took his nephew Perdix, or Talos, as an apprentice. Perdix proved to be such a brilliant craftsman that Daedalus killed him in a jealous rage. After his crime, Daedalus fled to Crete. Minos, the king of Crete, hired Daedalus, who created many ingenious inventions while in the ruler's service. His work included the *labyrinth*, a mazelike building, which imprisoned a monster called the Minotaur (see **Minotaur**).

Daedalus helped Minos' daughter Ariadne elope with Theseus, the slayer of the Minotaur. As punishment for the crime, Minos imprisoned Daedalus and his young son, Icarus, in the labyrinth. In order to escape, Daedalus made two pairs of wings from feathers, wax, and thread. Daedalus and Icarus used the wings to fly from Crete. However, Icarus flew too close to the sun. The wax in his wings melted and he plunged to his death in the sea. Minos pursued Daedalus to Sicily. According to one story, Daedalus killed the king by scalding him in a specially constructed bathtub.

See also **Aeroplane** (picture: An ancient Greek story).

**Daendels, Herman Willem** (1762-1818), was governor general of the Netherlands Indies (now Indonesia) from 1808 to 1811. His main achievement was the construction of an important road from west to east Java.

Daendels was born near Zwolle in the Netherlands. He studied law and later served in the French revolutionary forces. In 1808, he arrived in Batavia (now Jakarta). His first task was to defend Java against the British. One of his measures was the building of a 1,000-kilometre road from Anyer to Panarukan, which helped the defence of Java against invasion by the British.

During his term of office, he took measure to discourage corruption. But his dictatorial way with the local princes made them dislike the Dutch. Daendels was accused of gaining personal wealth from his position. He was recalled in 1811. In 1815, he was appointed governor of the Netherlands colonies on the west coast of Africa. He died there in 1818.

**Daffodil** is a yellow flower that blooms in the early spring. It is a type of *narcissus*, and is a native of Europe, where it grows wild in the woods. The daffodil is also widely grown in gardens in other parts of the world.

There are many kinds of daffodils. The best-known daffodil is also called the *trumpet narcissus*. It has one blossom at the end of each stalk. The daffodil has a large





The daffodil is a yellow narcissus that blooms in the early spring. The best-known daffodil is the trumpet narcissus, above.

flower and five or six bluish-green leaves about 38 centimetres long. Daffodil bulbs should be planted in autumn. They should be planted about 20 centimetres deep, and about 13 centimetres apart. Daffodil bulbs are poisonous if eaten.

**Scientific classification.** Daffodils belong to the amaryllis family, Amaryllidaceae. They are *Narcissus pseudo-narcissus*.

See also **Bulb**; **Narcissus**.

**Da Gama, Vasco** (1469?-1524), was a Portuguese sea captain and explorer. He commanded the first fleet to reach India from Europe. Da Gama sailed around the Cape of Good Hope to India in the late 1490's. His voyage opened the first all-water trade route between Europe and Asia.

**Early life.** Da Gama was born in Sines, Portugal. He probably attended school in the town of Évora. As a young man, Vasco learned astronomy and navigation. Da Gama became a naval officer in 1492 and commanded ships along the coast of Portugal.

Another Portuguese sea captain, Bartolomeu Dias, had discovered a route around the southern tip of Africa in 1488. He had sailed around the Cape of Good Hope. In 1497, King Manuel I of Portugal asked da Gama to find a sea route to India by sailing around Africa. The king wanted da Gama to establish trading links between Portugal and India. Da Gama's father had been chosen to lead the expedition, but he died before the plans were completed.

**Voyage to India.** Da Gama commanded four ships, including the *Berrio*, the *Saint Gabriel*, and the *Saint Raphael*. He had a total crew of about 170 men. His navigational equipment included compasses, an astronomical instrument called an *astrolabe* (see *Astrolabe*), and astronomical charts.



Vasco da Gama

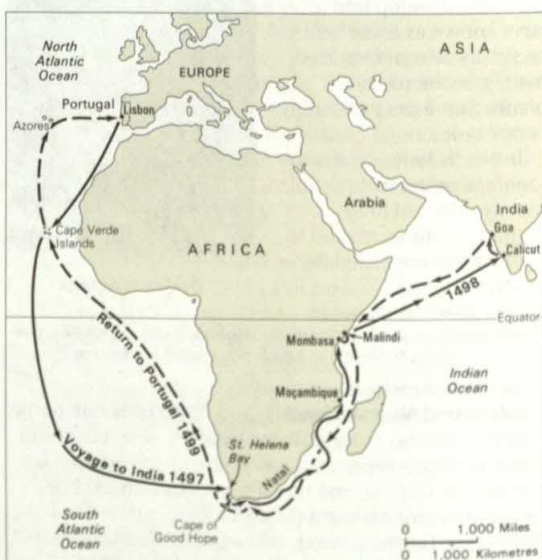
Da Gama sailed from Lisbon, Portugal, on July 8, 1497. He rounded the Cape of Good Hope on November 22, headed north, and stopped at trading centres that are now Moçambique, Mozambique; and Mombasa and Malindi, Kenya. Arab traders in Moçambique and Mombasa hated the Portuguese and tried to seize their ships. The people at Malindi were friendlier and arranged for a guide to lead the fleet to India.

On May 20, 1498, da Gama reached Calicut, India. But the Indian ruler felt insulted because he thought the gifts da Gama had brought him were of little value. In addition, Muslim merchants controlled trade in Calicut and resented European interference in their business. They continually threatened the Portuguese and would not trade with them. In August 1498, da Gama sailed for home with only samples of Indian goods. Many of the sailors died of disease during the voyage, and only 55 survived. Da Gama arrived in Lisbon in September 1499. King Manuel rewarded him and gave him the title of Admiral of the Sea of India.

**Later life.** The king sent another fleet to India in 1500 to break the Muslims' control of trade in that country. The Portuguese succeeded this time, and da Gama made a second voyage to India in 1502 to establish and expand trade there. He sailed from Lisbon with a fleet of 15 ships. Da Gama killed many innocent Indians and Muslims in revenge for various acts of violence against Portuguese sailors. Portugal soon became one of the most important trading and naval powers in the Indian Ocean.

After returning to Portugal in 1503, da Gama retired from the sea. In 1519, he was made Count of Vidigueira, which entitled him to collect taxes and rents in two Portuguese villages. In 1524, King John III named him viceroy of India. Da Gama sailed to India, where he died that same year.

See also **Exploration** (The voyage around Africa).



**Vasco da Gama** sailed from Portugal to India in 1497 and 1498. His historic voyage, which is shown on this map, opened a new trade route between Europe and Asia.



**Dagger** is a small, handheld weapon with a short, pointed blade. Daggers are chiefly used for self-defense and sudden attack, but some have served purely ceremonial or decorative purposes. Daggers typically measure from 15 to 50 centimetres in length. Both edges of the blade are sharpened.



A **dagger** is a short-bladed weapon. The dagger shown above was used by British commandos during World War II.

Daggers have been used since prehistoric times. Most daggers have had metal blades, but some have been made of stone, bone, wood, and plastic. The earliest form of bayonet was a dagger with a tapered handle that would fit into the muzzle of a musket.

See also **Bayonet**; **Bowie knife**.

**Daghestan**, also spelled *Dagestan*, is a state, or autonomous republic, in the Russian Soviet Federative Socialist Republic. It lies on the west shore of the Caspian Sea. It has a population of about 1,719,000 and an area of 50,300 square kilometres. The capital is Makhachkala.

**Dagohoy, Francisco** (1704?-1774?), a Filipino patriot, led a revolt against Spanish colonial rulers of the Philippines in 1744. The revolt began after Dagohoy's brother, a popular constable on the island of Bohol, was killed while carrying out an official arrest. A Spanish parish priest refused to give the dead man a proper Christian burial in consecrated ground. Dagohoy considered this unjust and unfair. He swore to seek revenge and started a revolt. The rebellion quickly gained support and in a few weeks, Dagohoy had more than 2,000 followers. The revolt continued for many years after Dagohoy's death. In 1829, the Spaniards sent a large force of soldiers to Bohol and forced the rebels into submission.

**Dagon**. See **Samson**.

**Daguerre, Louis Jacques Mandé** (1787-1851), a French stage designer and painter, introduced the first popular form of photography. His pictures were called *daguerreotypes*.

Daguerre was born in Cormeilles-en-Parisis, near Paris. He became a talented theatre artist and operated a scenery theatre called the Diorama in Paris. There he displayed huge painted scenes from nature, using lighting to create the illusion of changing views. A desire to improve these scenes led him to work with J. N. Niépce, a French scientist who had invented the first photographic technique. Daguerre discovered the daguerreotype process in 1837.

See also **Photography** (History).

**Daguerreotype** was the first popular method of photography. It was named after Louis J. M. Daguerre, a French inventor who perfected the process in 1837. The word *daguerreotype* also refers to photographs produced by this process.

Daguerre's process involved treating a thin sheet of silver-plated copper with fumes from heated crystals of iodine to make the silver plating sensitive to light. The



A **daguerreotype** was an image on a copper plate.

sheet was then placed inside a camera and exposed through the camera lens for 5 to 40 minutes. After the sheet was removed from the camera, it was developed by vapours from heated mercury. The mercury combined with the silver at the points where it had been affected by light, and formed a highly detailed image. The image was then *fixed* (made permanent) by treating the sheet with sodium thiosulphate.

Daguerre first published a description of his process in 1839. The process was soon improved by several other inventors. By 1841, for example, the exposure time for the pictures had been reduced to less than a minute.

Daguerreotype portraits were popular during the 1840's and 1850's, but the daguerreotype was eventually replaced, chiefly because it produced no negatives from which copies could be made.

See also **Daguerre, Louis J. M.**; **Photography** (History); **Talbotype**.

**Dahl, Roald** (1916-1990) was a prolific writer of children's stories, adult fiction, and film scripts. His stories are marked by nightmarish or fantasy elements, grotesque humour and surprise endings. His most popular books for children are *Gremlins* (1943), *James and the Giant Peach* (1961), and *Charlie and the Chocolate Factory* (1964).

Dahl's adult fiction includes the short-story collections *Kiss Kiss* (1960), *Tales of the Unexpected* (1979), and *Roald Dahl's Book of Ghost Stories* (1983). He wrote the screen plays for the James Bond film *You Only Live Twice* (1967) and the children's classic *Chitty Chitty Bang Bang* (1968).

Dahl was born in Wales of Norwegian parents.

**Dahlia** is the name of a popular group of flowers cultivated from the original dahlia of Mexico. Some dahlias are ball-shaped; others have long, flat petals. *Cactus dahlias* have double blossoms with long, twisted petals.





The dahlia is a popular garden flower.

Dahlias are now grown throughout temperate regions of the world. They are named after the Swedish botanist Anders Dahl.

Dahlias grow from *tuberous*, or thick, fleshy roots that look somewhat like bulbs. They should be planted in rich, well-drained soil, and in full sun after all danger of frost has passed. After the first frost, the roots should be dug up and stored for the winter in a cool, dry place. Storing the root clump with soil attached will stop shrivelling. At planting time, the roots should be separated and planted about 15 centimetres deep. Dahlias flower in the late summer.

**Scientific classification.** Dahlias belong to the composite family, Compositae (Asteraceae). Garden dahlias are *Dahlia pinnata*.

See also **Flower** (picture: Garden perennials [Bulbs]). **Dahomey**. See **Benin** (country).

**Dáil Éireann**. See **Ireland**, Government of.

**Daimler, Gottlieb** (1834-1900), a German engineer, developed an internal-combustion engine light enough to power a car. He and Wilhelm Maybach worked with motors for years, and produced a motor-bicycle in 1885. They made a four-wheeled car in 1886. The Daimler Company was founded in 1890, and produced the Mercedes car. The Daimler and Benz companies merged to make the Mercedes-Benz car in 1926.

See also **Car**; **Benz, Karl**; **Manufacturing** (table: 25 leading manufacturers); **Motorcycle** (picture); **Maybach, Wilhelm**.

**Daimyo**. See **Samurai**; **Japan** (Rise of the shoguns).

**Dairying** is the branch of agriculture concerned with the production of milk, butter, evaporated milk, ice cream, cheese, and dried milk products. It also includes the care and feeding of the cattle that give the milk. Dairying is carried out in most countries. Denmark, France, Italy, New Zealand, and Switzerland are among the countries that are famous for their dairy products.

There are about 220 million cows throughout the world. They produce some 470 billion litres of milk annually. The average annual milk production per cow is nearly 2,200 litres, but milk yields vary widely in different parts of the world. In the Netherlands, Scandinavia, and the United States, each cow may give from 5,000 to

6,000 litres in a year. In some developing countries individual annual yields may be no more than 100 litres. Some of the better dairy herds average almost 9,000 litres of milk per cow.

In all countries, fluid milk and cream form the largest proportion of dairy products. Butter, cheese, and other products, such as evaporated milk and dried milk, make up the rest.

The Soviet Union led the world in milk production in 1988, with 106 billion litres. The United States ranked second with 66 billion, and third came India, with a combined cow and water buffalo milk production totalling 47 billion. France and West Germany were Europe's largest producers.

Although cattle produce 90 per cent of the world's milk supplies, other animals are important to dairying in many countries. In France, Greece, and Italy, sheep's milk is used to make certain cheeses. Goats are also an important dairy animal, particularly in poorer countries. People in Arab lands drink camel's milk. Laplanders drink reindeer milk, and the people of China, Egypt, and India are among those who use the milk of water buffalo.

### Dairy farms

Almost every country has a dairy farming industry, but dairy farming is most highly organized and concentrated in Australia, Europe, New Zealand, North America, and other developed countries, where commercial and state dairy farms may have more than 1,000 cows each. The developed countries produce almost 70 per cent of the total supply of dairy produce. The developing countries presently supply only 31 per cent of their milk needs. Vietnam, Korea, and Thailand have an average milk consumption per head of only 3 kilograms a year, and in parts of China consumption is less than 1.5 kilograms. In contrast, many developed countries consume more than 300 kilograms of milk per head of population per year.

**Dairy cattle.** The most important breeds of dairy cattle are the Holstein-Friesian, Jersey, Guernsey, Ayrshire, Brown Swiss, and Milking Shorthorn. Initially bred and developed in Europe and the United States, these breeds have been introduced to dairy herds around the world. They vary in size and colour. The Brown Swiss is generally the largest breed, weighing about 680 kilograms. The Jersey, at 450 kilograms, is the smallest. The breeds are also distinguished by the composition and amount of their milk. Holsteins are among the most popular breeds because they produce a high volume of milk. Jerseys are popular as well because of the richness of their milk, which has 5 per cent *butterfat* (the natural fat in milk), and has a high protein content.

**Milking.** Dairy farmers usually milk their cows at regular times, once each morning and once each evening at 12-hour intervals. In a number of countries, however, where labour costs are low, milking may be done three times daily because it has the effect of increasing the flow of milk by an average of 5 per cent. Milking machines are now almost universally used to produce the world's milk. These machines are attached to the cow's teats and pump the milk directly from the cow through a glass pipeline from the well-ventilated milking parlour into a separate milk house. This system keeps the milk



clean. The dairy has vats for washing equipment and a tank where the milk is cooled and stored until the farmer can remove it.

Most top-grade milk comes from dairy farms that meet strict quality codes and standards. On some farms, workers step into a pan of disinfectant before entering the milking parlour. They carefully wash the cows' udders to remove impurities before milking. During the milking, the workers rinse the utensils periodically. After they have finished milking, they wash and sanitize all equipment including the pipe through which the milk runs into the milk house. They also wash the dairy and milking parlours.

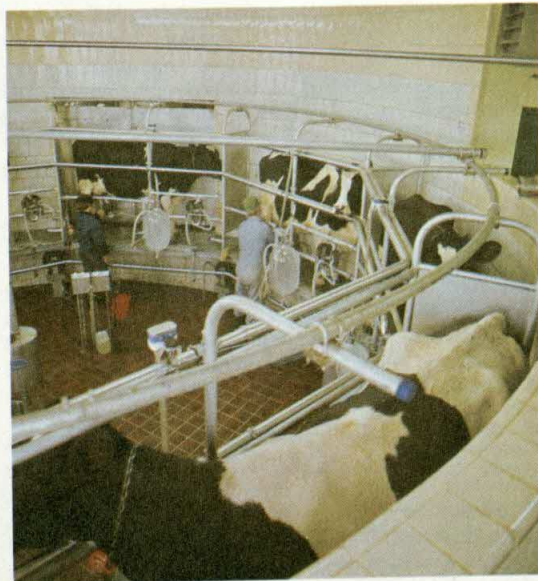
**Housing.** There are two main types of housing systems for dairy cattle: *confinement housing* and *loose housing*. In confinement housing, farmers keep their cows in individual stalls at all times, except for milking and brief exercise periods. In the loose housing system, cows are free to move around. In warm weather, cows in the loose housing system may go out to pasture between milkings. In the confinement housing system, cows remain under restraint in stalls in the barn or cowshed.

**Feeding.** A good dairy cow may weigh up to 770 kilograms. Most high-producing herds are fed indoors rather than put out to pasture. Workers bring in the feed, and the cows eat together at long troughs. Such cows eat large amounts of *concentrates* and *forages*. Concentrates are grains, dried beet pulp, molasses and associated foodstuffs. Forages consist of pasture (grasses, legumes, and other plants), hay, and *silage* (chopped-up stalks of corn and other crops). Farmers usually store hay in the barn or loft or in a hay shed. Silage is stored in a silo where it ferments.

Cows that produce a large amount of milk need feed that provides energy, proteins, and essential vitamins and minerals. Dairy farmers try to balance a cow's diet, and provide all feed nutrients in the proper amounts and proportions. For example, if farmers feed their cows a low-protein forage, such as corn silage, they increase the amount of protein in the concentrate mixture. Some forages that supply both protein and energy are alfalfa, clover, corn silage, and mixed hays.

**The economics of dairying.** Dairy farming requires large financial investments, either by private funding in developed countries, or by government support in developing countries and those with centrally-planned economies. Money invested in dairy farming includes the price of land, cattle, buildings, and equipment. Each cow must produce enough milk each year to cover all costs of production. Profits for dairy farmers are usually small. Dairy farmers can, however, make good profits with high milk-yield per cow, efficient operation, and the use of labour-saving technology.

**Improvements in dairy farming.** Today's farmers have greatly increased milk production efficiency through improved methods of breeding, feeding, and managing dairy cattle. Various organizations, both national and international, have contributed to the increased efficiency of dairy farming. In the United States, such organizations include Dairy Herd Improvement associations and the Purebred Dairy Cattle Association. In Europe, the European Animal Producers Association has made a major contribution at both continental and inter-



The milking parlour of a dairy farm is a special room where the cows are milked by machines. The milk is then piped to a refrigerated tank.

national levels. Perhaps the most important role in developing countries has been that of the United Nations Food and Agriculture Organization (FAO).

Many dairy cows are now bred by *artificial insemination*. Dairy farmers inseminate the cows by placing *semen* (sperm-containing fluid) from a donor bull in the reproductive organs of the fertile cows. A bull used by an artificial-insemination organization can be mated to more than 3,000 cows a year. This method enables farmers to increase the use of outstanding purebred bulls to improve herd quality.

**Dairy farming regulations.** An increasing number of countries are introducing legislation to regulate the conditions under which dairy farmers can produce and sell milk. These laws are essential because of the many ways in which milk can be contaminated. The regulations demand the highest standard of cleanliness and hygiene and set up strict procedures for limiting the spread of diseases such as tuberculosis or brucellosis.

Most laws regulating dairies require that the operator has a licence. In countries where strict controls have been imposed, dairy inspectors make sure that the farms meet sanitary regulations. Workers in dairies and milk plants undergo physical examinations periodically to make sure they are healthy. The milk is tested to ensure that its composition meets the legal standard and that it contains no impurities or disease-causing bacteria. With today's processing equipment and refrigerated tank trucks, dairy managers can ship milk long distances easily and safely.

### World trade in dairy products

The world market for dairy products is dominated by the European Economic Community, the United States, and New Zealand. Domestic milk production in devel-



oped countries has for more than two decades, exceeded demand. Many of these developed countries have set up surplus milk disposal schemes. In these schemes, heavily subsidized milk is used for school milk, special groups, livestock feeding, exports, and for food aid.

Developing countries account for most dairy imports. These imports make up one-eighth of the countries' total consumption. Four-fifths of these dairy products are imported as food aid. In the past, many developing countries imported ample supplies of cheap or entirely free milk products from developed countries. These supplies kept consumer prices low in the developing countries. However, the goal for the future is to improve self-sufficiency in milk production in developing countries.

**Related articles** in *World Book* include:

Agriculture	Hay	Pasteurization
Butter	Milk	Pasture
Cattle	Milking machine	Silo
Cheese		

**Daisy** is a name given to many flowers. The name comes from the Old English words for *day's eye*. It refers to the fact that daisy blossoms, like an eye, close at night and open at dawn. Daisy blossoms actually consist of many small flowers of two types—tiny *disc flowers* in the centre and petallike *ray flowers* around the edge.

English daisies belong to the genus *Bellis* and are true daisies. The leaves are bunched at the bottom of the stem, leaving the stalk naked. The blossom consists of yellow disc flowers and white, pink, red, or purplish rays. English daisies rarely grow over 15 centimetres tall. The blossoms measure nearly 5 centimetres across.

Several species known as daisies are included in the *genus*, or scientific grouping, *Chrysanthemum*. These species usually have yellow disc flowers and white or yellow rays. One member of this group—the oxeye, or white, daisy—originated in Europe and western Asia. It is the most common wild daisy in North America. The oxeye daisy grows in fields and on roadsides. It grows up to 1 metre tall, with blossoms up to 5 centimetres across.

The Shasta daisy is a popular cultivated member of the *chrysanthemum* group. It was developed by the famous American horticulturist Luther Burbank. It is a large, sturdy plant that grows over 1 metre tall, with blossoms that measure as much as 10 centimetres across.

**Scientific classification.** Daisies belong to the composite family, Compositae (Asteraceae). The English daisy is *Bellis perennis*. The oxeye daisy is *Chrysanthemum leucanthemum*. The Shasta daisy is *C. X superbum*.

See also **Black-eyed Susan**; **Composite family**.

**Dakar** (pop. 978,523) is the capital and largest city of Senegal and the westernmost city on the mainland of Africa. Dakar is Senegal's major seaport and an important industrial and transportation centre. For location, see **Senegal** (map).

Dakar's port is a centre of trade. The city's economic activities include food processing, printing, tourism, and the manufacture of cement, cigarettes, shoes, soap, and textiles. An international airport and the University of Dakar are in the city. Dakar has modern buildings and buildings of French colonial architecture. It also has *shantytowns* (areas of shacks and huts).



**The oxeye daisy** is a common plant that has a centre of tiny yellow disc flowers surrounded by white petallike ray flowers.

Dakar began to grow in 1857, when a French fort was built on the site of a settlement there. It later became the capital of French West Africa. Senegal became an independent nation in 1960. Many people have since moved to Dakar from rural areas, and the city faces housing and unemployment problems.

**Dakota.** See **North Dakota**; **South Dakota**.

**Daladier, Édouard** (1884-1970), served as French premier in 1933, 1934, and from 1938 to 1940. He agreed at Munich in 1938 to let Hitler partition Czechoslovakia (see **Munich Agreement**). After France fell to Germany, he was imprisoned from 1941 until 1945. He testified against Marshal Henri Philippe Pétain in 1945, accusing him of collaborating with Germany. Daladier was born in Carpentras, in Vaucluse, France.

**Dalai Lama** is the spiritual leader of the Tibetan people. He is the head of the Yellow Hat sect of Lamaism, a branch of Buddhism. The Dalai Lama was also the political ruler of Tibet until the 1950's.

Tibetans believe that each Dalai Lama is a reincarnation of the previous one. Once a Dalai Lama dies, Tibetan priests search the country for a male baby born around the time that the death occurred. The boy remains the responsibility of the regency council until the age of 18.

The first Dalai Lama (1391-1475) founded the Tashilhunpo monastery in central Tibet. He was its first abbot. During the 1600's and 1700's the political power of the Dalai Lamas increased considerably.

The 14th and current Dalai Lama (1935- ) was born in China of Tibetan parents. He became the Dalai Lama in 1940. In October 1950, the People's Republic of China invaded Tibet and began to curtail the power of the Dalai Lama. After nine years, the Tibetan people staged an uprising against the Chinese rulers. There was much fighting and bloodshed, but the Chinese government managed to suppress the revolt. The Dalai Lama escaped with most of his ministers and followers. He fled into exile in India where he was granted political asylum, and he has remained there ever since.

There have been many demonstrations by the Tibetan



people for the return of the Dalai Lama. Talks between the Chinese government and the Dalai Lama over the years have failed to find a solution to the problem. The Dalai Lama has spent his years in exile campaigning through nonviolent demonstrations for the liberation of the Tibetan people. He has spoken out about his vision for world peace. His devotion to peace earned him the 1989 Nobel Peace Prize.

**Dales** are beautiful valleys, situated chiefly in North Yorkshire. Important dales, named after rivers that flow through them, include Nidderdale, Ribblesdale, Swaledale, and Wharfedale. Wensleydale is named after Wensley village. The area known as the *Dales* covers about 5,000 square kilometres. It has a 1,500-square-kilometre national park. The area has mountains, moors, lakes, rivers, waterfalls, woodland, and grass-covered, rolling hills. The highest single waterfall in England is at Hardraw Scaur, at the top of Wensleydale. It is 30 metres high.

**Dali, Salvador** (1904-1989), was a surrealist painter. His unusual pictures made him one of the most publicized figures in modern art.

Dali called his surrealist paintings "hand-painted dream photographs." The pictures show strange, often nightmarish combinations of precisely detailed figures and objects. Many of his paintings have strong sexual associations. The barren landscapes and fantastic rock formations of the Spanish region of Catalonia, where Dali was born, appear in a number of his works. Dali's *Gala and the Angelus of Millet Immediately Preceding the Arrival of the Conic Anamorphoses* illustrates his realistic technique and his use of complicated, puzzling

symbols. This painting is reproduced in colour in the **Painting** article. Dali also created many etchings and lithographs. He designed many of these prints to illustrate books.

Salvador Felipe Jacinto Dali was born in Figueras, Spain. He was also a sculptor and jewellery designer. Dali worked with the Spanish film director Luis

Buñuel on two surrealist feature films—*An Andalusian Dog* (1929) and *The Golden Age* (1930).

See also **Surrealism**.

**Dall sheep.** See **Bighorn** (with picture).

**Dallapiccola, Luigi** (1904-1975), was an Italian composer. He became best known as a pioneer of *dodecaphony* in Italy. Dodecaphonic music is a twelve-tone technique. Dallapiccola's musical style is characterized by delicate *counterpoint* (multiple melodies), lyrical lines and textures, and subtle tone colours.

Dallapiccola's two-act opera *Ullisse* (1968) first brought the composer international fame. His compositions for solo voice and instrumental ensemble of the 1950's and 1960's rank among his finest works. Dallapiccola also composed two one-act operas, a ballet, the oratorio *Job*, numerous choral and solo vocal works, and a few works for piano and for chamber ensemble. He was born in Pazin (now in Slovenia), near Trieste.



Salvador Dali



Dali's *Accommodations of Desire* was completed about 1929. This oil and collage painting shows the mysterious combination of realistic figures and objects typical of the artist's style.





**Dallas** includes such landmarks as the 72-storey NCNB Plaza building, the city's tallest skyscraper, and the domed Reunion Tower. Dallas is one of the largest U.S. cities.

**Dallas** is one of the largest cities in the United States. It is the second largest city, after Houston, in the Southwestern state of Texas.

Dallas lies on the rolling prairies of north-central Texas, about 48 kilometres east of the city of Fort Worth (see **United States of America** [political map]). The Trinity River divides Dallas into two sections. The main business district lies north and east of the river.

Universities, museums, and performing arts organizations make Dallas a cultural centre of the U.S. Southwest. The Dallas area is also the home of professional U.S. football, baseball, and basketball teams. On every January 1, two of the top U.S. college football teams play in a game at the city's Cotton Bowl stadium. It draws national attention.

U.S. President John F. Kennedy was assassinated in Dallas on Nov. 22, 1963. Vice President Lyndon B. Johnson, who succeeded Kennedy, took the oath of office as president aboard the presidential aeroplane at Love Field in the city.

**Economy.** Dallas is a major U.S. centre for the manufacturing of electronics and electrical equipment, aircraft and missile parts, oil field equipment, and women's clothing. Other important industries include printing and publishing and the production of nonelectrical machinery, food, and food products. More than a fourth of the city's workers are employed in manufacturing. The city has about 4,000 factories.

The state of Texas is a major cotton-producing area, and Dallas is one of the world's leading cotton markets. Dallas also serves as the headquarters of many oil firms. More than three-quarters of the known U.S. oil reserves, excluding those in Alaska, are within 800 kilometres of Dallas.

More than 100 banks, including a district Federal Reserve Bank, are in the Dallas metropolitan area. Dallas is also the headquarters of many insurance companies. The Dallas-Fort Worth Airport, which lies about midway between the two cities, is one of the busiest U.S. airports.

**History.** John Neely Bryan, a lawyer and trader, founded Dallas in 1841. He built a trading post on the Trinity River and traded with westward-bound wagon trains, American Indians, and buffalo hunters. He soon began selling land in the area. In 1855, a group of French scientists, writers, artists, and musicians settled near Dallas to form a cooperative community. The community failed, and many of its residents moved to Dallas.

During the American Civil War (1861-1865), Dallas served as an administrative centre of the Confederate Army. Railways reached Dallas in the early 1870's. Farm tool manufacturers then began opening branches in Dallas. Hunters brought buffalo hides to the city, and small factories started to produce leather goods. Wholesalers began to supply retail stores around the city.

In the late 1800's and early 1900's, the growth of transportation and trade caused a rapid increase in the city's population. In 1930, the discovery of a great East Texas oil field helped boost the city's economy and growth.

World War II (1939-1945) brought aircraft factories and other defence industries to Dallas. After the war, many large companies, including Chance Vought Aircraft (later part of LTV Corporation), moved to the city. The industrial expansion continued to spur the growth of the city.

During the 1960's and 1970's, the Dallas suburbs grew faster than the city itself. To reverse this trend, the people of the city supported a "Goals for Dallas" plan. It led



## Facts in brief

**Population:** City—1,006,877. Metropolitan area—2,553,362.

**Area:** City—979 km<sup>2</sup>. Metropolitan area—12,067 km<sup>2</sup>. Consolidated metropolitan area—18,643 km<sup>2</sup>.

**Climate:** Average temperature—January, 8° C; July, 29° C. Average annual precipitation (rainfall, melted snow, and other forms of moisture)—88 cm.

**Government:** Council-manager. Terms—2 years for the council members; manager appointed.

**Founded:** 1841. Incorporated as a town, 1856; as a city, 1871.

to the construction of the Dallas-Fort Worth Airport and other improvements. In the 1970's, much construction took place in Dallas as large companies continued to move to the city. The building boom continued into the 1980's.

**Dalles** are deep gorges in which North American rivers flow rapidly over basaltic rocks or slabs. The name comes from the French *dalle*, meaning *slab* or *tile*. The singular form of dalles in English is *dell*, and in many areas these gorges are called *dells* instead of *dalles*.

French explorers gave the name *dalles* to scenic gorges of North American rivers, especially those located in the northern part of the United States. Notable dalles in the United States include the *Wisconsin Dells* on the Wisconsin River, near Wisconsin Dells, Wisconsin; the *Saint Louis River Dalles* near Duluth, Minnesota; and the *Saint Croix River Dalles* between Wisconsin and Minnesota.

**Dallin, Cyrus Edwin** (1861-1944), an American sculptor, used American Indian life as the theme for many of his greatest works. *The Appeal to the Great Spirit* (1908) is typical of his realistic and dramatic style. His other works include *Signal of Peace* (1890), *Medicine Man* (1899), *Brigham Young and the Pioneers* (1900), and *Paul Revere* (1940). His *Sir Isaac Newton* (1895) stands in the Library of Congress in Washington, D.C. Dallin was born in Springville, Utah. He studied at the École des Beaux-Arts and the Académie Julian in Paris. He taught in Boston.

**Dalmatia**, a district of Yugoslavia, is a long, narrow strip of land extending over 320 kilometres along the

eastern shore of the Adriatic Sea. Dalmatia is part of Croatia, one of the six republics of Yugoslavia. The Dalmatian coast is deeply indented and fringed with hundreds of islands.

Dalmatia lies in the Dinaric Alps. The chief rivers are the Neretva and the Krka. They flow into the Adriatic Sea. The most important cities are Split, Dubrovnik, Šibenik, and Zadar.

Most of the people are Croats, but a few Italians also live there. Tourism is Dalmatia's main industry. Each year, millions of people flock to the warm, sunny Dalmatian coast for such activities as boating, swimming, and sunbathing. Cherries, grapes, olives, and other fruits are grown in valleys near the coast.

Dalmatia was once part of the ancient kingdom of Illyria. The Romans conquered Dalmatia in the 200's B.C. Later, between the A.D. 600's and 1400's, the Slavs invaded Dalmatia. After the defeat of Napoleon in 1815, the Great Powers gave Dalmatia to Austria. In 1918, after World War I ended, Dalmatia became part of what is now Yugoslavia.

**Dalmatian** is a medium-sized dog. It is white, covered with many black or liver-coloured spots. Dalmatian puppies are pure white when born. The spots appear after about three or four weeks. Dalmatians make good watchdogs. They are alert, curious, clean, and useful. They also can be taught to hunt. Another name for the Dalmatian is the *coach dog*. These dogs used to run along between the wheels of coaches or carriages, and were companions to the horses. The breed was named after Dalmatia, an area on the Adriatic Sea, but experts are not sure where the dogs were first raised. See also **Dog** (picture: Nonsporting dogs).

**D'Almeida, José** (1784-1850), was a doctor and pioneer businessman in Singapore. He became a leader of the local Portuguese community and was appointed consul-general for Portugal.

José D'Almeida was born in São Pedro do Sul in Portugal. He worked for a short time as a surgeon on a Portuguese ship sailing between China and India. In 1825, he settled in Singapore, where he worked as a doctor before he gave up medicine to establish a trading company. He was a keen botanist and experimented with planting cotton and vanilla. He also planted gamboge, a plant from which gum resin is extracted. See **Gum resin**. He took samples of gutta-percha to London and this product later became an important export item for Singapore and Malaysia. See **Gutta-percha**.

**Dalton, John** (1766-1844), an English chemist, formulated the *law of partial pressures in gases* in 1802. The law states that for an ideal gas the total pressure of a confined gas mixture equals the sum of the pressures each gas would exert alone in the same volume. In 1803, Dalton proposed an *atomic theory of matter* that became one of the foundations of chemistry. From this theory, Dalton determined chemical formulas that showed the atomic composition of molecules. Dalton made the first, although inaccurate, table of atomic weights. He also investigated colour blindness (called *Daltonism*), which he had. Dalton was born in Eaglesfield. See also **Atom** (The birth of the modern atomic theory); **Chemistry** (picture: John Dalton).

**Daltonism.** See Colour blindness.

**Daltrey, Roger.** See **Who, The.**



**Dalles**, also called *dells*, are deep gorges. The scenic Wisconsin Dells, above, are located on the Wisconsin River, U.S.A.



**Dam** is a barrier placed across a river to stop the flow of water. Dams vary in size from small earth or rock barriers to concrete structures that rise as high as a skyscraper. People have always had to gather water during wet seasons to have enough for themselves, their animals, and their crops in dry spells. Ruins of ancient dams exist in the Tigris and Nile river valleys. Some Roman dams built in Italy, Spain, and North Africa are still being used today.

Throughout history, wherever people settled, an important first concern was to locate an adequate water supply. In many regions, streams full of water during certain seasons of the year become dry at other times, perhaps when water is most needed. At first, people built small dams of logs, earth, and rock that would store enough water for immediate needs. But floods frequently washed these small dams away. As communities grew and populations increased, people learned to construct larger dams that would provide a more permanent and abundant water supply. These dams could store enough water to meet people's needs during seasonal drops in the water supply and during drought periods covering several years. Later, people learned how to harness the energy of falling waters and use it to produce electric power for homes and industries.

#### What does a dam do?

As a barrier across a river or stream, a dam stops the flow of water. It then stores the water, creating a lake or reservoir, and raises the level of the water almost as high as the dam itself. The stored water is available for many uses. The dam also raises the water surface from the level of the original riverbed to a higher level. This permits water to be diverted by the natural flow of gravity to adjacent lands. The stored water also flows through hydraulic turbines, producing electric power that is used in homes and industries. Water released from the dam in uniform quantities guarantees water for fish and other wildlife in the stream below the dam. Otherwise, the stream would go dry there. Water released in larger quantities permits river navigation throughout the year. Where dams create large reservoirs, flood-

waters can be held back and released gradually over longer periods of time without overflowing riverbanks.

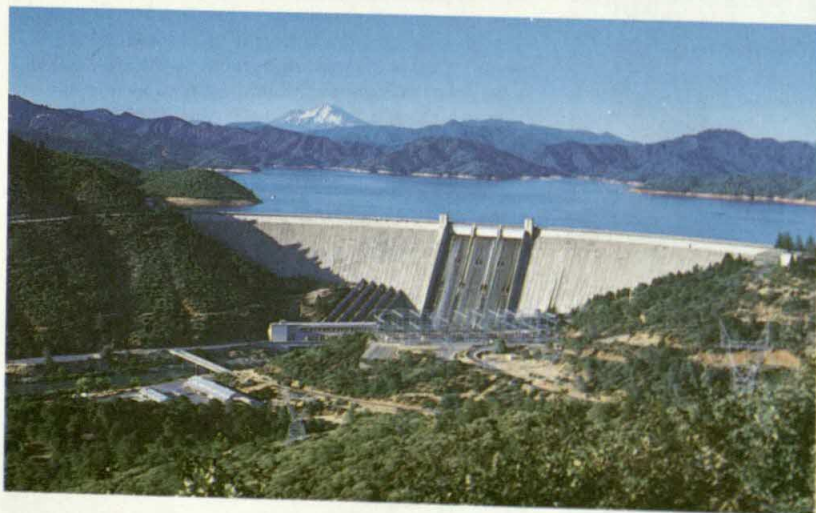
Reservoirs or lakes created by dams provide recreational areas for water sports and angling. They give refuge to wildlife. They help preserve farmlands by reducing soil erosion. Much soil erosion occurs when rivers flood their valleys, and swift floodwaters carry off the rich topsoils.

#### Kinds of dams

People build many kinds of dams. Each dam is built to suit the character of the damsite and the materials available for its construction. *Rock-fill* or *stone masonry dams* may be most economical where rock is abundant. *Timber dams* are built where logs are plentiful. Concrete is a common construction material for dams, but cement and gravel are not always available without heavy transportation costs. *Earth dams* prove most economical in many locations. In some locations, building *hollow dams* saves materials. In narrow canyons, thin *arch dams* may prove most suitable. But in wide river valleys, where the length of the dam would be very great, multiple-arch dams, flat-slab dams, and dams built of earth, steel, or timber may be the most economical.

**Masonry dams.** Several types of dams qualify as masonry dams. But, in general, these are dams built of solid materials. Structures made of stone cut in shapes, or of concrete poured into interlocking blocks or segments to form a solid mass, are called *masonry dams*. A *gravity dam* is generally made of concrete or cut-stone blocks. Such a dam depends for stability primarily on the weight of the materials used in its construction.

To conserve materials, and where the weight required for the stability of the dam can be reduced, engineers have designed modifications of the gravity dam. A *hollow dam* has a hollow portion inside its main body. If the dam's face is held up by supporting walls or buttresses, the dam is called a *buttress dam*. A *flat-slab dam* has a flat slab placed across buttress supports at an angle of about 45°. It is designed so that the weight of the water holds down the slab. In some cases, the slab can be formed into an arch that is supported by the but-



**Shasta Dam** in California, U.S.A., creates a huge reservoir on the Sacramento River. It is one of the highest concrete dams in the United States.





**Kariba Dam** is located on the Zambezi River. The dam is operated jointly by Zimbabwe and Zambia. It forms part of one of the world's largest hydroelectric projects, providing about 35 per cent of Zimbabwe's electricity generating capacity. The Kariba Dam forms Lake Kariba, which covers 5,300 square kilometres.

### World's major dams Highest dams

Dam	Country	Type	Height (metres)
Rogun	Tajikistan	Earth/Rock-fill	335
Nurek	Tajikistan	Earth-fill	300
Grand Dixence	Switzerland	Gravity	285
Inguri	Georgia	Arch	272
Boruca	Costa Rica	Earth/Rock-fill	267

### Largest capacity reservoirs

Dam	Country	Type	Reservoir capacity (cubic km)
Owen Falls	Uganda	Gravity	2,700
Kariba	Zimbabwe/Zambia	Arch	180.6
Bratsk	Russia	Earth/Rock-fill	169.3
Aswan High	Egypt	Earth/Rock-fill	168.9
Akosombo	Ghana	Earth/Rock-fill	148.0

### Largest dams (by volume of structure)

Dam	Country	Type	Volume (cu. metres)
Chapeton	Argentina*	Earth-fill	296,000,000
Pati	Argentina*	Earth-fill	238,000,000
New Cornelia Tailings	United States	Earth-fill	209,500,000
Tarbela	Pakistan	Earth/Rock-fill	148,500,000
Fort Peck	United States	Earth-fill	96,050,000

\*Under construction.

### Largest hydroelectricity plants

Dam	Country	Capacity (MW)
Itaipu	Brazil/Paraguay	12,600
Guri	Venezuela	10,300
Grand Coulee	United States	7,460
Sayano-Shushensk	Russia	6,400
Krasnoyarsk	Russia	6,000

trusses. The arch is between each pair of buttresses. This structure is called a *multiple-arch dam*.

**Embankment dams.** The *earth-fill dam* is the most common type of embankment dam. This dam is constructed by hauling selected earth materials into place,

and compacting layer upon layer with heavy rollers to form a watertight mass. Materials placed in the dam are graded according to density, with the fine materials located in the centre. Coarser materials are placed in outside zones, blanketed with a cover of rock, called *riprap*. This serves as an outside protection against the wave action of the reservoir and against wind, rain, and ice. Walls made of reinforced concrete to cut off water passage are frequently used in the centre section. These cut-off walls may be made of sheet-metal piling driven deep below the excavated foundation level. Frequently, thinned-out cement, called *grout*, is pumped under great pressure into the foundation. It fills cracks and fissures, thus supplementing the cut-off walls and making the foundation watertight.

*Semihydraulic-fill* and *hydraulic-fill dams* are other modifications of the embankment dam. These dams are constructed by pumping wet, fine materials into their central sections, and allowing the water to drain off. Where rock is available, it may prove most economical to build a *rock-fill dam*. Most dams of this type are constructed of coarse, heavy rock and boulders. These are graded in size to permit them to fit together more compactly. Such dams, however, must have other means of preventing water from passing through them. Many of them have a blanket of concrete, steel, clay, or asphalt on the side facing the water. This blanket makes the dam watertight. Combinations of rock and earth result in a type of dam called an *earth-and-rock-fill dam*. Some of the embankment dams are formed from *mine tailings*, the waste materials that mining operations produce.

**Other types of dams.** *Timber dams* are built where timber is available and the dam is relatively small. The timber is weighted down with rock. Planking or other watertight material forms the facing. *Metal dams* have watertight facings and supports of steel.

Dams with movable gates are built where it is necessary to let large quantities of water, ice, or driftwood pass by the dam. A *roller dam* has a large roller located horizontally between piers. It can be raised and lowered. When the roller is raised, ice and other materials



pass through the dam without much loss of reservoir water level. Many kinds of gates or wickets are used in these dams. Common types include the *taintor-gate dam*, *beartrap dam*, and *wicket-gate dam*.

In 1966, France completed a dam on the Rance River at St.-Malo for the world's first tidal power plant. St.-Malo has some of the world's highest tides. Tides average 11 metres and rise to a maximum of about 13 metres. Water fills the dam during high tide and flows through turbines during low tide.

### How dams are built

In order to construct a dam, the builders must first gather and study much information. The site where the dam is to be erected must be examined for its formation, quality of foundation, and the availability of suitable construction materials. A careful analysis must be made of the stream-flow characteristics. The area to be covered by the reservoir that the dam creates must be outlined when determining the height of the dam at any given site. This requires detailed topographic mapping and geologic studies. Subsurface drillings are necessary to determine the condition, quality, and location of the rock formation under the dam site.

All property in the reservoir area must be bought or relocated. This occasionally requires the relocation of entire towns, roads, railways, and utilities. Engineers must also determine the amount of mud, silt, and debris which the dam will stop. This will determine the useful life of the reservoir, because when the reservoir becomes filled with this material it can no longer store water. If the dam is to be used for generating power, outlets must be provided which will connect to generating equipment. If the water is to be used for irrigation or municipal supply, outlets to control its release to canals or aqueducts must be built.

When the dam site has been selected, means must be found to remove or bypass the flow of the stream from the riverbed so that the foundation can be excavated and the concrete, earth, or rock placed. To divert the flow of the river from the area, frequently half of the riverbed is excavated at one time. The other half of the riverbed is used for the flow of the river. In some cases, it



A hand-operated dam may be used to hold water for irrigation. This dam is on the Canal du Midi in southern France.

is more economical to bore a tunnel through an adjacent valley wall. The tunnel permits the entire flow of the river to pass around the site. To accomplish this diversion, *cofferdams* (small dams placed temporarily across a stream) are built upstream to divert the river into the tunnel. After the dam has been built high enough, the diversion tunnel is closed with gates, and permanently plugged. The dam has a *slipway* to bypass water when the reservoir is full.

In order to release water from behind the dam when the reservoir is not full, dams are equipped with reservoir outlets. These outlets consist of specially designed valves which can be opened and closed under high water pressure. Some of the many kinds of valves used for this purpose are called *needle valves*, *gate valves*, *slide valves*, and *cylinder gates*.

### Some important dams

In countries with low or irregular rainfall, such as India, Australia, and South Africa, dams with large storage capacities are used to provide water for



Water from Fort Peck Dam's reservoir is used by two powerhouses, left, to generate electricity. The dam's slipway, right, carries excess water to the Missouri River.







**The Tungabhadra Dam**, in southern India, regulates the flow of seasonal monsoon rains to provide irrigation for about 8,000 square kilometres of cropland, as well as electricity. The dam was completed in 1957.

irrigation of farmland. Countries with more regular rainfall, such as the United Kingdom and New Zealand, have smaller dams which are used mainly for water supply or for hydroelectric power generation.

India has two of the ten highest dams in the world, Tehri (261 metres) and Kishau (253 metres), due for completion in the 1990's. Other high dams in India are Bhakra (226 metres), and Lakhwar (204 metres). The highest dam in the United States is Oroville, California, at 235 metres. The Hoover Dam in the United States, completed in 1936, is still 20th highest in the world at 226 metres.

The highest dams in Australia are Dartmouth (180 metres) on the Mitta Mitta River in Victoria and Talbingo (162 metres) on the Tumut River in the Snowy Mountains Scheme. New Zealand's highest dam is Benmore (118 metres) on the Waitaki River. South Africa's highest dam is P. K. Le Roux on the Orange River with a height of 107 metres. The highest dam in the United Kingdom is Llyn Brianne in Wales, at 91 metres.

The largest capacity dam in India is Upper Waiganga, at 50.7 cubic kilometres (km<sup>3</sup>). Australia's largest capacity dam is Gordon, Tasmania, at 11.3 km<sup>3</sup>. Pukaki High in New Zealand has a capacity of 5.8 km<sup>3</sup>. Hendrik Verwoerd Dam, South Africa, has a capacity of 5.9 km<sup>3</sup>.

Very large capacity hydroelectric dam schemes due for completion in the 1990's include Turukhansk, in Siberia, Russia, with a planned capacity of 20,000 megawatts (MW). Itaipu (Brazil/Paraguay), completed in 1992, has a capacity of 12,600 MW. Grand Coulee (United States) is being upgraded to 10,830 MW. India's largest

hydroelectric plant is Tehri, with a planned capacity of 1,800 MW. The Dinorwic plant in Snowdonia, Wales, has a capacity of 1,800 MW. Talbingo in Australia has a capacity of 1,500 MW. Australia's Snowy Mountains Scheme provides both irrigation water and hydroelectricity, by having large storage capacity dams upstream and downstream of the hydroelectric plants.

**Related articles** in *World Book*. See the *Electric power* section of various country articles. See also:  
Aswan High Dam      Grand Coulee Dam

#### Other related articles

Brazil (picture: The Itaipu Dam)	Reservoir
Electric power	Snowy Mountains Scheme
Flood	Turbine (Water turbines)
Irrigation	Water power
Lake (picture)	

#### Outline

##### I. What does a dam do?

##### II. Kinds of dams

- A. Masonry dams
- B. Embankment dams
- C. Other types of dams

##### III. How dams are built

#### Questions

Why do we need dams?  
Where is the world's highest dam? The largest reservoir?  
How do dams help farmers?  
What materials are commonly used in building a dam?  
How do builders decide where to construct a dam?  
What is a *cofferdam*?  
Under what circumstances are *roller dams* necessary?



**Damages**, in law, means money that a court orders one person to pay to another person for violating that person's rights or for breaking a contract. To collect damages, a victim ordinarily must show that loss or injury has been suffered because of the other person's fault or carelessness or breach of contract.

The main types of damages include *compensatory*, *general*, *nominal*, and *punitive* damages. Compensatory damages, also known as *special damages*, are recovered only for actual damage, such as the cost of repairing a car damaged in an accident. Most damages are compensatory. General damages are based on indications of harm, including pain and suffering. They are awarded for personal injuries and in *libel* and *slander* cases where it may be hard to show how one's reputation was harmed by a person making false statements. Nominal damages are small token awards given in cases where a person's rights have been violated, but where no harm has occurred. Cases fought on principle may be settled in this way. Punitive damages are in effect a fine levied against the wrongdoer. They are given in addition to other damages, when the wrongdoer has purposely harmed the other person.

There are complicated rules of law on how to measure damages based on previously decided cases. Damages may vary with each case, because the circumstances may be different. Damages may include elements that are hard to measure in money, such as pain and suffering.

See also **Negligence; Tort.**

**Daman and Diu** (pop. 101,439) are two districts that form one of the Union Territories of India. These two districts are 792 kilometres apart. Daman (an area of 74 square kilometres) lies on the Gujarat coast. Diu is an island with an area of 38 square kilometres. It lies on the southern coast of the Kathiawar peninsula in the Gulf of Cambay (or Khambhat). Daman is the territory's capital.

Daman has a mild and humid climate, but the climate on Diu is sultry. The population of Daman and Diu speak Gujarati and Marathi. The religion of most of them is Hinduism.

The economy of Daman is based on agriculture and marine products. Trade forms a major economic activity. In Diu, fishing and saltmaking are important occupations. Plantations of casuarina trees are found in both districts. In Diu, such plantations have been remarkably successful in preventing shifting sand dunes from encroaching on nearby farmland.

Diu was a part of the kingdom of Gujarat, which was ruled by Sultan Bahadur Shah. It became an extension of the Portuguese empire in the 1600's when the Mughal army invaded Gujarat. Bahadur Shah sought the help of the Portuguese, and in return he gave them Bassein and the surrounding areas. He also allowed them to build a fort at Diu. The Portuguese captured Daman from Saiful-Mulk Miftah, a Gujarati nobleman, in 1559. Goa, Daman, and Diu remained in Portuguese hands even after India gained independence from Britain in 1947. They gained independence from Portugal in 1961. In 1962 Daman and Diu became an independent Union Territory.

**Damascus** (pop. 1,200,000) is the capital and largest city of Syria. It may have been founded about 5,000 years ago and is one of the world's oldest cities. Damascus is



**Damascus city centre** has numerous high-rise office blocks and flats to help relieve the city's accommodation shortage. New towns were planned to help solve the problem.

Syria's cultural, economic, and political centre. It lies in southwest Syria, between the Anti-Lebanon Mountains on the west and the Syrian Desert on the east (see **Syria** [map]).

**The city** is on an oasis in a semiarid plain. The Barada River flows through Damascus and has provided the area with water for thousands of years.

The southern section of Damascus includes an area



**Damascus** is the capital and largest city of Syria. Some sections of the city are hundreds of years old, but the main business district, *above*, has many buildings erected in the 1900's.



that is hundreds of years old. There, on narrow, winding streets, merchants sell a wide variety of goods in bazaars called *souqs*, just as their ancestors did. This area contrasts with the main business district in the northwest, which has many tall buildings erected during the 1900's. Many parts of Damascus and its suburbs have residential areas. Most of the people live in flats, but some have beautiful houses.

Cultural attractions in Damascus include the University of Damascus, the National Library, museums, and theatres. The city has many fine works of Islamic architecture. Among them are the Umayyad, or Great Mosque; the Mosque of Sultan Suleiman; and the tomb of Saladin, a Muslim leader of the 1100's.

**Economy.** Damascus is the chief Syrian centre of manufacturing, trade, tourism, and banking and other financial activities. Textile production and food processing are two of the city's largest industries. Fruit grown in nearby orchards is processed and canned in Damascus. In the old section of the city, craftworkers sell fabrics, metalware, and many other products.

Most of the people of Damascus use buses and taxis for local transportation. An international airport lies just outside the city.

**History.** Historians believe Damascus may have been founded about 3000 B.C. The city was important during the rule of several early empires, including those of the Assyrians, Greeks, Romans, and Byzantines. The Muslim Arabs captured Damascus from the Byzantines in A.D. 635. Under the leadership of the Umayyad dynasty, the Muslim Arabs made Damascus the capital of their vast empire in 661. But the Umayyads lost control of Damascus during the 700's, and the city went through a long period of anarchy and decline.

In 1154, the Syrian leader Nur al-Din made Damascus the capital. Saladin, the Muslim ruler of Egypt, took control of Damascus in the late 1100's. The city became a centre of trade. Most of its main historical monuments date from the late 1100's and the 1200's.

In 1516, the Ottoman Turks conquered Damascus. The city prospered as trade increased with neighbouring countries and with European nations. The Ottomans controlled the region until World War I (1914-1918). Combined Allied and Arab forces captured Damascus during the war. France took control of Syria in 1920.

Syria became independent in 1946, with Damascus as its capital. By the early 1980's, the city had almost four times as many people as it had in 1946, and a housing shortage resulted. New towns were established near Damascus to solve the problem.

See also **Syria** (picture).

**Damask** is a firm, lustrous fabric that may be woven from any fibre. Its flat, woven design appears on both sides of the fabric. Damask was originally a silk fabric produced in China. Traders introduced it to Europe by way of Damascus, Syria.

In table damask, the design may be sateen weave with *floats* (longer, raised threads) in the *filling* (cross-wise) threads. The background may be a satin weave with floats in the *warp* (lengthwise) threads. Single table damask has a four-float construction, and double damask has a seven-float construction. Damask's lustre depends on length of floats, length of fibres, closeness of weave, and uniformity of yarns.



Jacques d'Amboise danced with Suzanne Farrell in the ballet *Diamonds* at the New York City Ballet in 1967.

**D'Amboise, Jacques** (1934- ), an American dancer, won fame as a featured performer with the New York City Ballet. He earned particular recognition as the male lead in George Balanchine's ballet *Apollo*. Athletic jumps and a sparkling stage presence marked his style.

Jacques Joseph d'Amboise was born in Dedham, Massachusetts. He trained under Balanchine at the School of American Ballet. D'Amboise is remembered for roles in the ballets *Western Symphony* (1954), *Movements for Piano and Orchestra* (1963), *Meditation* (1963), and *Union Jack* (1976). As a *choreographer* (dance composer), he created *Irish Fantasy* (1964) and other ballets. D'Amboise appeared on TV and in films and directed or choreographed several Broadway musicals. In 1976, he established the National Dance Institute to introduce children to the arts through dance.

**Damien de Veuster, Joseph** (1840-1889), was a Roman Catholic priest who gave his life to the care of lepers in a colony at Molokai, Hawaii. Father Damien was born in Belgium and became a member of the Fathers of the Sacred Hearts of Jesus and Mary. He asked to be sent to Molokai as resident priest. But because of the difficulty in getting doctors, he was obliged to serve as a doctor as well. He was stricken with leprosy in 1885. Hawaii has placed a statue of Father Damien in the United States Capitol in Washington, D.C.

**Damocles** was a member of the court of Dionysius II, who ruled Syracuse, Sicily, from 367 to 344 B.C. Damocles was an excessive flatterer. The Roman orator Cicero, who lived in the 100's B.C., said that Damocles once talked too much about the happiness and good fortune of Dionysius. To teach Damocles a lesson, Dionysius invited him to a big feast. When he was seated, Damocles found a sword, suspended by a single hair, dangling over his head. This represented the constant danger that went with the wealth and material happiness of Dionysius. The *sword of Damocles* has become a byword for the threat of danger.

**Damon and Pythias** were two noble youths in Greek legend. Their friendship and loyalty to each other made them famous. Pythias had been condemned to death by Dionysius, ruler of the city of Syracuse. Pythias was allowed to leave Syracuse to put his affairs in order after Damon agreed to die in his place if Pythias failed to return. Although Pythias was delayed, he arrived just in



time to save Damon from death. Dionysius so admired this display of friendship that he pardoned Pythias and asked the two to become his friends. The name of Pythias was originally spelled *Phintias*. During the Middle Ages, scribes accidentally spelled it *Pythias*. That form of the name has been common since the 1500's.

**Damp** is a dangerous gas found in mines. It is most often found in coal mines, where it is a hazard to miners. *Firedamp* is the most common kind of damp. It is chiefly *methane*, a tasteless, odourless gas. Firedamp forms when decaying plant matter produces coal. It is trapped in seams or cracks in rock. When miners cut into the seams or cracks, the gas is released. The gas burns readily and can explode when mixed with air in certain proportions. Exploded firedamp leaves *afterdamp*, a deadly gas that contains poisonous carbon monoxide and nonpoisonous nitrogen and carbon dioxide.

*Chokedamp* and *blackdamp* are common names for carbon dioxide,  $\text{CO}_2$ , a gas that is denser than air. This gas gathers at the bottom of pits and low places in mines, reducing the amount of oxygen in the air. If too much  $\text{CO}_2$  is present, miners will suffocate. Miners once carried canaries to test for gases. They knew gas was present if the birds collapsed. Today, various mechanical, chemical, and electrical devices are used to test for the presence of gases.

See also **Methane**; **Coal** (Mine safety).

**Dampier** (pop. 2,201) is a deepwater port and township at King Bay on the northwest coast of Western Australia. The port was constructed by Hamersely Iron Pty. Ltd. as the chief outlet for iron ore from Mount Tom Price and Paraburdoo. It has an annual export capacity of 46 million metric tons of iron ore. The port has highly mechanized loading facilities. It also provides for the export of salt from a nearby solar salt farm. In the mid-1980's, a natural gas project was built to produce liquid natural gas for export. The town takes its name from the nearby Dampier Archipelago, which the British navigator William Dampier visited in 1699.

**Dampier, William** (1651-1715), was the first Englishman to make a written description of the Australian mainland, its plants and animals, and its Aboriginal inhabitants. He *circumnavigated* (sailed around) the world three times. He commanded a naval vessel and served on merchant ships.

Although Dampier was a failure as a commander of a ship, he was a most competent navigator, geographer, naturalist, and *cartographer* (map maker). His maps and sketches were among the most accurate made at the time. But his exciting, well-written books were what brought him fame in his own time and assured him of a permanent place in history. They had a strong influence on Daniel Defoe and many other later writers. Defoe, for example, based the main character of his famous novel, *Robinson Crusoe*, on Alexander Selkirk, a seaman who was marooned on the islands of Juan Fernandez during Dampier's second voyage around the world, and who was rescued during Dampier's third circumnavigation.

**Early life.** Little is known about Dampier's early life. He gives a brief description of his first years and sea adventures at the beginning of his *Two Voyages to Campeachy*. From this and from other records, historians know that Dampier was born in East Coker, Somerset.

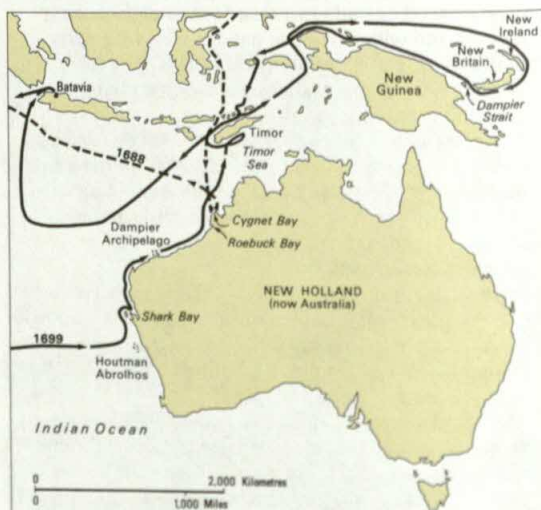
**The early voyages of Dampier** took him to France,



**William Dampier**, of Britain, visited New Holland (now Australia) as a privateer in 1688 and as an explorer in 1699.

Newfoundland, and Java. In 1672, he joined the British navy and served in the war against the Dutch. In 1674, he sailed from Jamaica, where he had worked for a brief time on a plantation. He spent the next four years working with log-cutters on Spanish colonial territories. He then sailed with buccaneers. He returned to England in 1678, where he married a woman named Judith, of whom little more is known.

**First circumnavigation (1679-1691).** Dampier's first



**William Dampier** landed at Cygnet Bay in 1688. In 1699, he explored the western coast of New Holland (now Australia) from Shark Bay as far north as Roebuck Bay.



voyage around the world began as a voyage to the West Indies. There he engaged in trading and again served with buccaneers in their attacks against Spanish vessels in the Caribbean and along the Atlantic and Pacific coasts of Central America. Growing weary of this, Dampier went to live in the British colony of Virginia. There, in August 1683, he joined the *Revenge* under a buccaneer named Cook and sailed by way of West Africa and Cape Horn to the Pacific to join a fleet seeking Spanish treasure ships. There Dampier transferred to the *Cygnets* under a certain Captain Swan.

In 1686, Captain Swan and Dampier left the buccaneer fleet and sailed the *Cygnets* across the Pacific to try their luck privateering in the East Indies. After reaching Guam, they went to Mindanao, where a six-month wait provided Dampier with the opportunity to write a detailed description of the natural life and customs there. Swan was left behind because of his tyrannical behaviour, and the *Cygnets*, under a Captain Read, sailed to Manila, Formosa, the Celebes, and northwest Australia, with Dampier as a virtual passenger. The *Cygnets* was in western Australian waters from Jan. 4, 1688, until March 12 of the same year. This extensive stay was made in order to clean the foul bottom of the *Cygnets*. The long stay provided Dampier with the opportunity to describe the plants and animals and Aborigines in the vicinity of Cygnets Bay, King Sound, where the *Cygnets* anchored.

Of all the countries Dampier had visited, nothing displeased him so much as northwest Australia. The soil was dry and dusty, and the unfamiliar vegetation bore no fruits or berries to eat. The local tribes seemed to Dampier to match their unattractive land. He considered them "the miserabest people in the world. The Hodmadods (Hottentots) of Monomatapa, though a nasty people . . . are as gentlemen to these . . . setting aside their human shape, they differ but little from brutes . . . their eyelids are always half closed, to keep the flies out of their eyes." He noted they had no housing "but lie in the open air without covering, the earth being their bed, and the heavens their canopy." Dampier was unable to communicate with the Aborigines. Some were warlike. Others were timid and ran away. Some proved friendly and were offered food delicacies and clothes, but they could not be coaxed to work to help prepare the ship for sea.

Dampier had decided to leave the *Cygnets*, which was having no success, and to give up the buccaneer's life with "this mad crew." His opportunity came in the Nicobar Islands, which the ship made for after leaving western Australia. Dampier subsequently sailed about the Dutch East Indies (now Indonesia) and then served as a gunner at the English fort at Bencoulen in Sumatra. In 1690, he determined to return home. He sailed on the *Defence* and landed in England on Sept. 16, 1691, after spending 12½ years in making his first circumnavigation. His only gain from the voyage appears to have been a native prince, Jeoly, from Mindanao, whom he sold in England as a curio to be put on show.

Little is known of Dampier's life from 1691 to 1697. He served on a merchant ship for a time and prepared his diaries for publication. When his *New Voyage Around the World* was published in 1697, it was an immediate success, and brought him fame and government employment.

**Voyage to New Holland.** Now regarded as an expert on the South Seas, Dampier sought, and was given, command of the naval vessel HMS *Roebuck*. It carried a crew of 50 men with provisions for 20 months. After many delays, he left England in this unseaworthy ship on Jan. 14, 1699, bound for New Holland by way of the Indian Ocean. From then on, Dampier was plagued by problems of maintaining discipline among a crew ready to stir mutiny, and of maintaining the health of the crew.

By early August 1699, the *Roebuck* was off the west coast of Australia near the Abrolhos Islands. Navigating by means of the chart made by the Dutch explorer Abel Tasman, Dampier sailed north to an inlet swarming with sharks and turtles. Dampier named this inlet Shark's Bay (now Shark Bay). He spent four days in a fruitless search for fresh water. On shore, there were many kangaroo rats, which he called *raccoons*. These animals provided a change of diet from biscuits and salted meat.

Proceeding north again, they passed a group of rocky islands later named *Dampier Archipelago*. The ship landed at Roebuck Bay, and the sailors began digging wells on the land, but found little water. Dampier described the local Aborigines as "much the same blinking creatures" that he had observed some years earlier at King Sound. When the sailors, who were armed with muskets and cutlasses, chased them, hoping to learn where they got water, the natives attacked with spears. Dampier was forced to shoot one of them, but was "sorry for what happened." Although a long chain of sandhills prevented the Englishmen from seeing the country inland, they observed dingoes near the landing place. Dampier likened them to "hungry wolves . . . nothing but skin and bones."

Having visited Australia a second time, Dampier made an interesting assessment of its geography: "New Holland is a very large tract of land. It is not yet determined whether it is an island or a main continent; but I am certain it joins neither to Asia, Africa, nor America."

As there was no fresh water available and his men were suffering from scurvy, Dampier abandoned further exploration of New Holland and set sail for Timor. There, the sailors spent three months in pleasant tropical surroundings. Then, having decided to investigate eastern Australian waters, Dampier steered the *Roebuck* along the northern coast of New Guinea, past the Schouten Islands to the St. Matthias group. He then skirted New Ireland. His passage through Dampier Strait proved that New Britain was an island. He gave New Britain its Latin name *Nova Britannia*.

The *Roebuck's* crew saw many of the local population, but could get nothing from them "except coconuts and water and had to take pigs by armed force." Dampier described the New Guineans as "strong . . . negroes whom we found very daring." He envisaged New Britain as an English spice island, and considered that the island might produce "as many rich commodities as any in the world."

If the *Roebuck* had been more seaworthy, Dampier would doubtless have braved the trade winds and voyaged south to discover the eastern coast of Australia long before Captain Cook was born. Instead, he let the prevailing winds carry him back along the New Guinea coast. By July 1700, the *Roebuck* was at the Dutch Indies port of Batavia (now Jakarta). The ship was in poor con-



dition, and even after an overhaul, the carpenter found her "more leaky . . . than she was before." The *Roebuck* never reached England. It sank at Ascension Island during the homeward voyage. The crew got safely ashore and were eventually rescued in April 1701. The results of this voyage proved disappointing to the Admiralty. New Holland was obviously unsuitable as an outpost against the Dutch in the Indies, and Dampier's discoveries in New Guinea and New Britain were of little interest to England.

**Later voyages.** Dampier made two more voyages round the world. From 1703 to 1707, he sailed the privateer ship *St. George* round the world in search of prize ships and booty. Discipline again proved to be a problem, and the voyage was a failure. From 1708 to 1711, Dampier sailed around the world on a further privateering expedition as a navigator on the *Duke*. Dampier died in London in March 1715.

**Damping-off** is a plant disease caused by certain fungi that live near the surface of the soil (see Fungi).



**Damping-off** is a plant disease that has no cure. But the disease can be prevented by selecting healthy soil or by treating the soil with fungicides.

The disease affects many kinds of plants. Damping-off kills *seedlings* (young plants) before they grow above the ground, or it destroys the stems of seedlings just above the surface of the soil. Damping-off cannot be cured. But growers can prevent the disease by planting seeds in soil free from fungi, or by treating the seeds or the soil with fungicides.

**Damrosch** was the family name of a father and son who spent their lives educating Americans to serious music. They came from a family of German musicians.

**Leopold Damrosch** (1832-1885), violinist and conductor, founded the New York Symphony Society in 1878, and conducted its orchestra until his death. Damrosch was born in Posen, Prussia (now Poznań, Poland). After receiving his degree in medicine from the University of Berlin in 1854, he joined the Weimar court orchestra as violinist under Franz Liszt. Damrosch went to the United States in 1871 to become conductor of the German Male Choral Society.

**Walter Johannes Damrosch** (1862-1950), son of Leopold, conducted the New York Symphony Orchestra in 1925 in the first symphonic programme ever broadcast

on U.S. radio. From 1928 to 1947, Damrosch served as musical counsel for the National Broadcasting Company. Children throughout the U.S.A. learned about great music by listening to the Music Appreciation Hour he directed. The music of such composers as Wagner, Stravinsky, Gershwin, Ravel, and Elgar became popular, in part, through Damrosch's efforts.

Damrosch was born in Breslau, Silesia, and went to America with his father in 1871. He succeeded his father as director of the Oratorio and Symphony societies of New York City in 1885. Later he founded the Damrosch Opera Company to present Wagnerian operas. Damrosch reorganized the New York Symphony Society in 1903, and then served as its conductor until 1927.

In addition to his conducting and educational work, Damrosch composed such operas as *The Scarlet Letter*, *Cyrano de Bergerac*, *The Man Without a Country*, and *Manila Te Deum*, celebrating Admiral George Dewey's victory.

**Damselfly.** See Dragonfly.

**Dana, Charles Anderson** (1819-1897), editor and part owner of the New York *Sun*, built it into one of the most important newspapers of its time. Dana and his associates paid 175,000 U.S. dollars for the *Sun* in 1868. Under his management its value rose to an estimated 5 million U.S. dollars. He made the *Sun* a witty, terse, and outspoken newspaper.

Dana was born on Aug. 8, 1819, in Hinsdale, New Hampshire. He studied at Harvard University. In 1842, he became a member of the Brook Farm Association, an experimental social community at West Roxbury, Massachusetts, and wrote for its publications, *The Harbinger* and *The Dial* (see *Brook Farm*). He joined the staff of the New York *Tribune* in 1847, and later became its managing editor. He resigned in 1862 because he disagreed with *Tribune* owner Horace Greeley about the newspaper's stand on the Civil War. Dana served as an assistant secretary of war from 1863 to 1865.

**Dana, Richard Henry, Jr.** (1815-1882), was an American author known for his sea adventure story *Two Years Before the Mast* (1840). The book became one of the most popular and influential sea stories ever written. Herman Melville said the excitement he felt while reading Dana's book helped inspire him to write his famous sea novel, *Moby-Dick*.

Dana was born in Cambridge, Massachusetts. He was forced to leave his studies at Harvard University because of poor eyesight caused by an attack of measles. In 1834, Dana sailed as a seaman from Boston around Cape Horn, arriving in California in January 1835. After spending about 17 months in California, he returned by sea to Boston. Dana kept a journal of his two voyages and his visit to California that became the basis of *Two Years Before the Mast*. He wrote the book in the form of a diary, realistically describing life at sea and providing a vivid account of Spanish California in the 1830's.

Dana was active in the antislavery movement before the Civil War (1861-1865) and helped form the antislavery Free Soil Party in 1848. He was also a noted lawyer and wrote *The Seaman's Friend* (1841), a manual of customs, terms, and laws relating to the sea. *To Cuba and Back: A Vacation Voyage* (1859) describes one of Dana's later sea voyages.

**Danaë.** See Perseus.



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A performance of the modern dance *Imago*



Religious dance of India



Dancing to rock music



An African dance

## Dancing

**Dancing** is an act of moving the body in rhythm, usually in time to music. People seem to have a natural urge to express their feelings through rhythmic movement. For example, most children jump up and down when they are excited and sway gently when content or at rest. In dancing, people organize the expressive movements of their bodies into rhythmic and visual patterns.

Dancing is both an art and a form of recreation. As an art, a dance may tell a story, set a mood, or express an emotion. A ballet dancer's movements, for example, can effectively describe the fluttering of a wounded swan.

Some Oriental dances consist of symbolic gestures that tell a story completely through movement.

As a form of recreation, dancing has long provided fun, relaxation, and companionship. Today, dancing either at a party or other gathering, continues to be a very popular way for people to enjoy themselves and to make new friends.

Prehistoric paintings found in Africa and southern Europe show people dancing. Social scientists believe that dancing may have played an important part in hunting and many other activities of prehistoric life. Scientists study the dances of various cultures because the kinds of dances a people do—and how and why they do them—can reveal much about their way of life.



### Why people dance

Most people dance simply to have fun or to entertain others. But dancing also serves many other purposes.

For many people, dancing provides one of the most personal and effective means of communication. A dancer can express such feelings as joy, anger, or helplessness without saying a word. Many schools and private studios offer classes in *modern dance*. These classes encourage students to express themselves through rhythmic movement. The field of dance therapy uses modern dance to treat physically handicapped and emotionally disturbed people.

In many societies, dancing plays a role in courtship. It serves as a way for men and women to become acquainted before they marry. Among some African peoples, girls announce their readiness for marriage by taking part in special dances. In most Western countries, secondary-school and university students get to know one another at dances.

Throughout human history, dancing has been used in worship. Prehistoric people probably made up religious dances to gain the favour of their gods. Many North American Indian tribes danced in appealing for rain and good crops. Many traditional religious dances are still done today. In Australia, for example, a few tribes of Aborigines follow their age-old custom of imitating the gestures of hunting during a religious dance before an actual hunt. An Islamic group called the *whirling dervishes* whirl and dance as part of their rites of worship (see *Dervish*). In some English villages, children dance around a ribboned Maypole on May 1 in a springtime celebration. This custom goes back to the ancient religious dances of the Romans, who ruled Britain from A.D. 43 until the early 400's. On May 1, the Romans worshipped Flora, the goddess of spring, by dancing around a Maypole decorated with flowers.

Dancing often serves to create a feeling of unity among the participants. In New Guinea, tribal war dances before a battle draw the community together and inspire the warriors to fight bravely. Some secret societies in Africa do a special initiation dance known only to their members. When new members learn the dance, it represents their acceptance into the group.

### Kinds of dancing

There are two major kinds of dancing—theatrical and social. *Theatrical dancing* is performed for the entertainment of spectators. Theatrical dance forms include ballet, modern dance, musical comedy dances, and tap-dancing. Theatrical dancers may take great personal satisfaction in creating something beautiful. However, their own enjoyment and need for self-expression are less important than their ability to interpret the dance effectively for the audience.

In *social dancing*, the participants dance for their own pleasure rather than for the entertainment of an audience. There are many types of social dances. Most of them have specific steps and rhythms, but many newer ones allow the dancers to compose their own movements as they dance.

All types of theatrical and social dancing involve movement, energy, rhythm, and design. *Movement* is the action of dancers as they use their bodies to create

organized patterns. *Energy* provides the force needed to perform movement. *Rhythm* is the pattern of timing around which the dance movement is organized. Most dance movement is related to the rhythm of accompanying music. *Design* refers to the visual pattern made by the movements of a dancer's body.

The rest of this section deals with four of the most important kinds of dance in the Western world. They are the theatrical forms of ballet and modern dance and the two types of social dancing, folk dancing and popular dancing. The next two sections discuss dancing in Asia and in Africa.

**Ballet** began in the royal courts of Italy in the 1400's. The special movements of ballet still include bows and other elegant manners that reflect its courtly origin.

Ballet dancers learn how to hold their bodies to achieve the ideal upright posture of ballet. Their bearing is open and direct as they perform their movements. Classical ballet technique is based on positions and movements in which the legs rotate outward from the hip joint. This rotation is known as the *turnout*. It enables the dancer to move freely in any direction.

In ballet, the trunk of the body remains relatively calm, while the arms and legs extend outward to form meaningful designs. The *line* of a dancer's body is very important in both performing and appreciating ballet. Line refers to the way a dancer displays clarity of design and to how closely a dancer's body proportions express the ideal for ballet. Today, ideal proportions include long arms and legs and a thin, well-shaped trunk.

Ballet themes and styles have changed greatly over the years. The first works called ballets were based on stories that had a moral or political meaning. These works resembled plays, but they featured dance sections known as *entrées*. The movements of early ballet dancers differed from those of dancers today because the early dancers were court nobles, who performed special versions of social dances of their times. In addi-



**Ballet dancers** combine technical precision with the ability to express emotion through movement. Rebecca Wright and Kirk Peterson of the American Ballet Theatre are shown above in a performance of *Harlequinade* (1965) by George Balanchine.



tion, heavy, elaborate costumes limited their movements.

Many ballets of the 1800's told stories of delicate, imaginary creatures. These ballets emphasized the quick, light movements of graceful women dancers performing on their toes. Male dancers served mainly to lift the women to show how light they were. In the early 1900's, a famous Russian company, the Ballets Russes, introduced new strength and energy to male technique.

Since about 1900, the length of ballets has varied from short works lasting about half an hour to full-length ballets several hours long. Some modern ballets tell a story. Others describe a mood or express the feelings and movements aroused by the music or by some other factor, such as a painting or nature. Current dance styles reflect the speed, pressures, and complexity of modern life. For an extensive discussion of ballet, see the article *Ballet*.

**Modern dance** developed in the early 1900's. The leaders of the modern dance movement believed that the techniques of ballet were artificial and meaningless. They searched for fresher, more personal ways to express ideas through dancing. Pioneers of the movement included Isadora Duncan, Loie Fuller, and Ruth St. Denis of the United States; Emile Jaques-Dalcroze of Switzerland, Rudolf von Laban of Hungary, and Gertrud Bodenwieser in Australia.

Isadora Duncan was one of the most free-spirited of the modern dance pioneers. She danced in her bare feet and wore loose-fitting garments that allowed her freedom of movement. She permitted no scenery onstage, which might draw attention from her dancing. Duncan ignored the formal, set movements of ballet. Her own flowing movements were inspired by nature, classical music, and Greek drama and sculpture. Duncan's ideas greatly influenced the development not only of modern dance but also of ballet.

Oriental religions inspired the dances of Ruth St. Denis. She won fame during a tour of Europe from 1906 to 1909. In 1915, St. Denis and her husband, Ted Shawn, opened the famous Denishawn School of Dancing.

Mary Wigman became Europe's first great modern dancer. She founded an influential dance school in her native Germany in 1920.

Since the 1940's, creativity in modern dance has centered on U.S. dancers and dance companies. The most experimental dancers have included Merce Cunningham, Alvin Nikolais, Paul Taylor and Twyla Tharp. Modern dance works today place less importance on emotion and personal expression. Instead, they explore movement for its own sake. For example, dancers may make patterns with their bodies merely to form interesting pictures. Dancers may also use movements, such as walking, that are more natural than the movements used by earlier performers. Today's dances even include tumbling, rolling, and other acrobatics. Ballet companies have adopted some modern dance techniques and have begun to invite modern dance *choreographers* (dance composers) to work with them. As a result, the gulf between ballet and modern dance has narrowed greatly.

**Folk dancing** is a form of social dancing that has become part of the customs and traditions of a people. Well-known folk dances include the square dance, the Irish jig, and the polka. Most folk dances developed



**American musical comedy** has inspired some of the most imaginative dances ever created. The dance above is from the brilliant Broadway musical *A Chorus Line* (1975)—a show that pays tribute to the chorus dancers in musical comedies.

among people in villages and were passed on from generation to generation in a particular region. In many of these dances, groups of dancers form such basic patterns as a circle, a line, or a curved, moving line called a *chain*. In some folk dances, women and men dance together in couples. But in many other dances, such as Greek village dances, only men or women perform.

Although folk dances are preserved by repetition, they gradually change over the years. English, Scottish, and Irish settlers took their dances to Australia and the United States, and other European settlers have also contributed their traditions. As a result, folk dances have not only survived in these countries but have changed to suit the character of local communities.

For example, originally barn dances were country



**Folk dancing** is the traditional form of social dancing of a particular nation or ethnic group. The couples shown above are performing a folk dance that originated in Scotland. This type of dance is passed down from generation to generation.



dances held in barns. In the same way, the polka now danced in the United States looks different from the polka danced in Europe during the 1800's, although the music and basic steps resemble the original style.

Today, folk-dance classes and societies are stimulating interest in folk dancing in Australia, Britain, Canada, and the United States. Many of these groups perform in costume for entertainment, and so help preserve the heritage of the folk dance.

For additional information on folk dancing, see the article **Folk dancing**.

**Popular dancing** is the kind of dancing people do for fun. They may dance to live bands in ballrooms or to recorded music in nightclubs called *discothèques*, or *discos*. People also dance at parties and other social gatherings. Popular, or social, dances include such old favourites as the waltz and the cha-cha, as well as the latest rock dances. Early social dances known as *court dances* developed among the European nobility in the 1100's from the folk dances of the peasants. However, these social dances were more dignified than the high-spirited folk dances from which they originated.

Social dancing differs from folk dancing in several ways. For example, the steps of many social dances have been carefully recorded on paper. In addition, social dancing has been formally taught by dancing masters since as early as the 1400's. Folk dances, on the other hand, have been largely unrecorded, and most people learn to do them simply by watching folk dancers and then imitating their steps. Social dances often spread quickly throughout much of the world, but folk dances usually remain closely identified with the regions where they developed.

Most social dances are fads that become associated with the period in which they were popular. The most fashionable dances of one period are generally out of date in the next. Some popular dances were considered shocking when they first appeared. Many people in the early 1800's thought the waltz was disgraceful because it required close contact between partners. In the 1920's, "cheek-to-cheek" dancing to jazz music was condemned as sinful. The suggestive movements of some rock dances of the 1950's and 1960's were criticized as vulgar.

Ballroom dancing, by contrast, has remained a universally popular form of social dancing. In the United Kingdom and Ireland, as well as other European countries, competition ballroom dancing is held so that couples can compete for dance titles and prizes at several levels. They compete for titles at area, national, European and world championship levels.

There are four main sections. *Modern dancing* includes the foxtrot, quickstep, tango, waltz, and Viennese waltz. The *Latin-American* section dances are cha-cha, jive, pasa doble, rumba, and samba. *Sequence dances* include 25 different old-time dances, as well as sequences in modern or Latin-American style. *Freestyle*, or *disco* dancing, does not have specific dances but has special routines designed for each piece of music.

### Oriental dancing

In parts of Asia, dance traditions are thousands of years old. Most theatrical dance forms of Asia were performed originally as part of religious worship or for entertainment. Many folk dances also developed in Asia,

but modern social dances reflect Western influences. Asians have deep respect for tradition, which has encouraged dancers to make existing theatrical dance forms perfect rather than to create new styles.

In most of Asia, dance, drama, and opera did not develop as separate art forms, as they did in the West. Traditional forms of Asian theatre combine dance, music, pantomime, speech, and sometimes puppetry. The performers often wear elaborate costumes and fantastic masks or makeup. In some Asian theatrical dances, slight movements of the upper body—especially facial expressions and hand gestures—communicate the message of the dance. Every movement, even a raised eyebrow, may have significance. Many dances describe, through gesture, a historical event, a legend, or a myth.

Some theatrical dance performances in Asia take place outdoors and last all night. People in the audience leave and return as they please. A famous performance of this type held in Burma is called *pwe* (pronounced *pweh*). At a *pwe*, spectators may shout out comments, tease the performers, and go backstage to watch them put on costumes and makeup.

Religion and magic are major themes of much Oriental dancing. *Bharata Natyam*, a dance originally performed in the temples of India, combines rhythmically complicated dancing with Hindu legends told in song and pantomime. Like other Indian dance forms, this temple dance uses *mudras*—hand gestures that have recognized meanings.

In Southeast Asia, *trance dances* blend superstitions with Buddhist, Hindu, and Islamic beliefs. During the *Barong*, a theatrical dance form performed on the Indonesian island of Bali, dancers in a trance act out a legendary battle between a dragon and a witch. The dancers turn knives on themselves. But in most cases, the trance prevents them from feeling pain and helps protect them from injury. Members of the audience rescue performers who become too violent, unless they themselves go into a trance.



**Oriental dancing** is based on thousands of years of tradition. These two dancers from the Indonesian island of Bali perform a dance with stylized movements and expressive gestures.





Hand-coloured woodcut (about 1685) by Sugimura Jihei; Mary Andrews Ladd Collection, Portland Art Museum, Portland, Oregon, U.S.A.

**The lion dance**, which originated in China, is a Japanese folk dance. It is performed in the streets during harvest festivals and other celebrations and in theatrical dance productions.

Some of the most important theatrical dances of Asia began as entertainment for royalty. Two popular Japanese dance dramas, *no* and *kabuki*, developed from a majestic court procession called the *bugaku*, which started in the 800's. The Peking Opera began in the court of the Chinese emperor in the late 1700's. The opera's dances and other traditional features, such as skilful acrobatics and pantomime, colourful costumes, and symbolic makeup, still delight audiences today. During the 1950's, China began to develop a dance form called *revolutionary ballet*. This form uses the strength and speed of Western ballet style to express Communist themes.

### African dancing

Dancing developed in Africa as an essential part of village life. It emphasizes the unity among the members of a village. As a result, African dancing is nearly always a group activity. On important occasions, ceremonial dances with special symbolic movements may be performed by professional dancers. But in most village dances, all the men, women, and children join in the dancing, or they clap their hands or form a circle around the dancers and call out to them.

Every important event in African life is observed by dancing. Such events include birth, death, the planting of crops, and even the dedication of a public building. Dancing is a major feature of festivals held to thank the gods for a rich harvest. Ceremonial hunting dances are performed throughout Africa. Other dances celebrate the passage of young people from childhood to adulthood. In addition, Africans dance for entertainment at weddings and on other occasions.

African dances vary widely from region to region, but most dances share certain characteristics. Participants

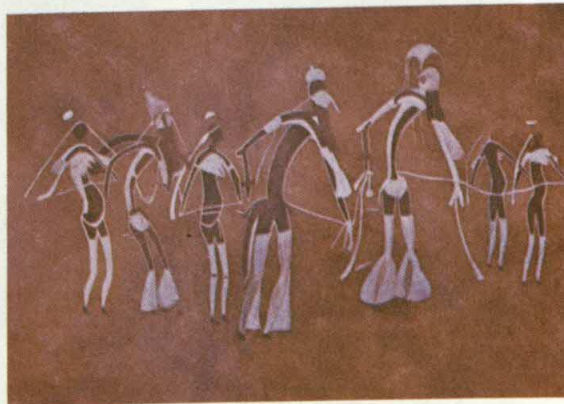
usually dance in a single line, in two parallel lines, or in a circle. They seldom dance alone or with a partner. African dances feature as many as six rhythms at once. Each part of the dancer's body—the head, the trunk, the arms, and the legs—may follow the rhythm of a different instrument at the same time. Precise control of the parts of the body and of the designs they make is less important than the continuous, natural flow of movement. African dancers sometimes wear masks. They may also decorate their bodies with paint to make their movements even more expressive.

### The development of Western dance

**Prehistoric times.** Dancing was one of the earliest forms of artistic and personal expression. Prehistoric paintings of dancers have been found on cave walls in Africa and southern Europe. These paintings may be more than 20,000 years old. Religious ceremonies that combined dancing, music, and drama probably played an important part in the lives of prehistoric people. These ceremonies may have been held to worship the gods and to ask them for success in hunting and in battle. Ceremonial dances may also have been performed for such reasons as to celebrate a birth, heal the sick, and mourn the dead.

**Ancient times.** Both sacred and nonreligious dancing existed during ancient times, especially in the regions around the Mediterranean Sea and in the Middle East. The paintings, sculptures, and writings of ancient Egypt provide information about early Egyptian dancing. For example, decorative carvings found in Egyptian tombs show that dances were performed during funerals, parades, and religious ceremonies. The Egyptians were an agricultural people, and their major religious festivals centred on dances honouring Osiris, the god of vegetation. Dancing also provided private entertainment. For example, slaves danced to entertain wealthy families and their guests.

The ancient Greeks regarded dancing as essential to education, worship, and drama. The Greek philosopher Plato urged that all Greek citizens be taught to dance to develop self-control and skill at warfare. Weapon



Rock painting from Tassili-n-Ajjer, Algeria

**Prehistoric dancers** are pictured in paintings up to 20,000 years old. Such paintings, found on rock surfaces, prove that dancing is one of the oldest forms of human expression.





Mural (about 1350 by an unknown Danish artist; Orslev Church, near Sorø, Denmark (National Museum, Copenhagen))

**The chain dance** became one of the most popular kinds of folk dances in the Middle Ages. Like other folk dances, it began among the peasants and was adopted by the nobility. *above*. Folk dancing played a major part in the celebration of weddings, holidays, and other festive occasions.

dances had already become part of the military education of boys in the city-states of Athens and Sparta. Colourful social dances were performed at weddings, harvesttime, and many other occasions.

Religious dances played a major part in the birth of Greek drama. During the 500's B.C., serious dramas called *tragedies* developed from a ceremony of hymns and dances in honour of Dionysus, the god of wine. The *emmeleia*, a dignified dance performed in tragedies, included a set of recognized gestures. A trained dancer could tell the entire story of a play through these gestures. Greek comedies and short, humorous plays called *satyr*s included lively dances.

By the time the Romans conquered Greece in 197 B.C., they had already adopted much of the Greek culture, including Greek dancing. Like the Greeks, the Romans developed dances for religious festivals. Roman entertainers danced as they juggled and performed acrobatics. In spite of the popularity of dancing, some important Romans disapproved of it. The orator Cicero claimed, "No man dances unless he is drunk or insane." In time, professional dancers came to be considered immoral.

**The Middle Ages.** During the Middle Ages, which lasted from about the A.D. 400's to the 1500's, the Christian church became the most influential force in Europe. Church officials in many areas prohibited theatrical dancing because some dances had become vulgar and included sexually suggestive movements. However, wandering dancers kept theatrical dancing alive by performing at fairs and in villages. By the 1300's, associations of craftworkers put on elaborate religious plays in which dancing was a popular feature (see **Drama** [Medieval drama]).

During the 1300's, a plague known as the *Black Death* swept across Europe, wiping out a fourth of the population. The constant threat of disease and death tormented some people to near madness. People sang and danced frantically in graveyards. They believed such acts would drive away demons and keep the dead from escaping from their coffins to infect the living. Disease, superstition, and fear of the plague drove some people to dance wildly in procession from place to place until they fainted or fell dead.

Throughout the Middle Ages, Europeans continued to celebrate weddings, holidays, and other festive occasions with folk dances. The peasants, adults as well as children, performed sword dances and danced around Maypoles. Other folk dances included chain dances and

such dance games as ring-a-ring o' roses, which still delights children today. The nobility developed more elegant versions of the peasants' folk dances. Lords and ladies danced a circle dance called the *carol* in a slower, more dignified manner than the peasants' original lively style. During the late Middle Ages, dancing became part of the spectacle associated with the splendid banquets, tournaments, and parades of the nobility.

**The Renaissance** was a period of great economic and cultural growth. The Renaissance began in Italy about 1300, during the late Middle Ages, and spread throughout most of Europe by 1600. In Italy, the nobility of nearly every prosperous city tried to outdo the nobles of other cities in staging elaborate entertainment at the royal courts. They hired professional dancing masters to create original court spectacles that included dances called *balli* or *balletti*.

Spectacles were presented to celebrate such events as birthdays, weddings, and visits by foreign officials. Members of the court took turns performing for one another in various groupings and arrangements. The productions combined poetry, dancing, music, and scenic effects. Some spectacles included fireworks, water shows, mock battles, and parades. Leading composers wrote the music, and the most talented artists, including the great Leonardo da Vinci, designed costumes and special effects.

Catherine de Médicis, a member of the ruling family of Florence, Italy, became queen of France in 1547. She introduced Italian dance and spectacle into the French court. For a royal wedding in 1581, Catherine commissioned a group of Italian artists to come to Paris to create the magnificent *Ballet Comique de la Reine*, one of the first ballets ever produced. This kind of ballet became widely imitated throughout Europe.

In addition to producing spectacles, dancing masters taught social dances to the nobility. Lords and ladies danced such dances as the bouncy galliard, the dignified pavan, and the lively volta. Dancing also had special philosophical meaning during the Renaissance. Many people believed harmony of skilled dance movement reflected harmony in government, nature, and the universe.

**The 1600's and 1700's.** King Louis XIV of France, who lived from 1638 to 1715, greatly encouraged the development of ballet. His support of dancing and the other arts helped make France the cultural centre of Europe. Louis himself enthusiastically danced in court ballets for 20 years. One of his favourite roles, that of the



Greek sun god Apollo, helped earn him his nickname, "the Sun King."

During Louis' reign, ballet came to have its own professional performers and a formal system of movements. Performances were gradually moved from the royal ballroom to a theatre. The theatre had a *proscenium arch*, which framed the stage and set it apart from the audience. The arch symbolized the separation developing between the performers and the spectators.

Ballet technique for women became freer during the 1700's. Before that time, women wore long, heavy skirts, tight corsets, and heeled slippers—all of which severely limited their ability to jump and perform other energetic movements done by male dancers. But during the 1700's, women shortened their skirts to about mid-calf and eventually began to wear shoes without heels. Marie Sallé, a French dancer, wore loosely draped cloth to allow greater freedom of movement. Jean Georges Noverre, a French choreographer, helped develop a form of dance drama called *ballet d'action*. It stressed the use of movement to communicate a story or idea rather than merely to show off a dancer's skills.

The dances of the court ballets had been based on the social dances of the period. The most popular dances of the 1700's included the gavotte, the allemande, and the minuet. These graceful dances consisted of a complicated pattern of steps, glides, rises and dips, and bows and curtsies. Lively English folk dances called *country dances* also became favourites of the middle and upper classes throughout Europe. The invention of written systems of *dance notation* enabled people to learn dances by following diagrams printed in books. Some European dancing masters sailed to America to teach dancing and other social graces to the families of wealthy people. In the 1800's, French and British dancers opened dance schools in Sydney, Australia, and travelling dancing instructors toured country areas of Australia.



Engraving (1682) by Antoine Trouvain; Bibliothèque Nationale, Paris

**Magnificent court balls** were often staged in France under the reign of King Louis XIV, who ruled during the late 1600's and early 1700's. Louis' enthusiastic support of social dancing and ballet made France the dance centre of Europe.



Detail of *Der Hofball* (about 1900), a gouache painting on canvas by Wilhelm Gause; Vienna State Museum, Vienna, Austria

**The romantic waltz** became the most fashionable social dance of the 1800's. It originated in Germany and Austria and soon spread to other countries. Waltz music also added beauty and elegance to some of the period's best-loved ballets.

**The rise of romanticism** revolutionized the subject matter and technique of ballet during the 1800's. Romanticism was a movement in the arts that glorified individuality and freedom of personal expression. Previously, most ballets were about gods and goddesses, but they now focused on common people. Many ballet stories of the 1800's also included delicate, imaginary beings, such as fairies and *sylphs* (spirits of the air). Women portrayed these creatures by dancing on their toes. They wore fluffy knee-length or calf-length skirts called *tutus* and glided across a stage that was specially lighted to produce a magical atmosphere. The best-known romantic ballets include two works by French composers, *La Sylphide* (1832) by Jean-Madeleine Schneitzhoeffter and *Giselle* (1841) by Adolphe Adam.

Marius Petipa, a French choreographer who worked in Russia, and Lev Ivanov, his Russian assistant, transformed classic fairy tales into spectacular ballets during the late 1800's. They set their works to the beautiful music of the Russian composer Peter Ilich Tchaikovsky. Their best-known ballets—*Sleeping Beauty* (1890), *The Nutcracker* (1892), and *Swan Lake* (1895)—combine graceful movement with technical precision.

Throughout the 1800's, most of the new social dances that became popular in Europe and the United States began among the common people. Instead of largely setting the fashion, the European nobility again imitated the peasants, who danced the waltz and the polka. Social dancing in ballrooms became popular among the middle and upper classes.

In the United States, new forms of theatrical dancing developed or first became popular among the working class and the poor. Blacks developed tap-dancing by combining traditional African dances with the Irish jig and a lively English folk dance called the *clog*. Black performers tap-danced in such places as taverns and on street corners. By the 1870's, they also performed in travelling variety shows. Chorus girls danced the high-



Watercolour (about 1890) by Albert Meyers; Museum of Modern Art, New York City

**The cakewalk** started among American slaves as a high-stepping promenade that poked fun at the haughty ways of plantation masters. Dancers improvised steps to syncopated music. Whites began to dance the cakewalk about 1890.



kicking cancan, which originated in France, to entertain cowboys in dance halls along the rapidly expanding American frontier.

**Dancing since 1900** has shown a wide range of styles and much experimentation, beginning with the introduction of modern dance. The development of modern dance, which was based on freedom of movement and expression, is discussed in the subsection *Modern dance* earlier in this article.

The revolutionary ideas of modern dance led to major changes in ballet. The Ballets Russes, the great Russian company formed by Sergei Diaghilev, produced a number of powerful and even shocking ballets during the early 1900's.

One of Diaghilev's most famous new works was *The Rite of Spring* (1913). Its primitive-style dances by the Russian choreographer and dancer Vaslav Nijinsky and radical music by the Russian composer Igor Stravinsky set off a riot in the audience at the ballet's opening in Paris. By the 1960's, the leading ballet choreographers included George Balanchine, who had worked for Diaghilev and moved to the United States in 1933; Jerome Robbins; Antony Tudor; and Sir Frederick Ashton. Today's ballet styles and techniques include elements of jazz, modern dance, and rock, all of which evolved since the 1900's with strong influences from the rhythms of Latin-American and African music.

Theatrical dancing won its greatest commercial success in films and musical comedies. During the 1930's, many American film musicals featured the elegant ballroom dancing of Fred Astaire and Ginger Rogers and the spectacular production numbers of choreographer Busby Berkeley. Some of the best later musicals were *An American in Paris* (1951), *Singin' in the Rain* (1952), and *Seven Brides for Seven Brothers* (1954)—all of which included highly imaginative dance numbers. Many outstanding American ballet choreographers created brilliant dances for musical comedies, such as the work of Agnes de Mille in *Oklahoma!* (1943) and Jerome Robbins in *West Side Story* (1957).

Hundreds of new social dances have come and gone during the 1900's. About 1900, the strutting, high-stepping cakewalk was at the height of its popularity. A few years later, the ballroom dancers Vernon and Irene Castle introduced the tango. The tango originated in Argentina and was the first in a long series of popular Latin-American dances. During the 1920's, people danced the Charleston and the black bottom. In the 1930's and 1940's, they did the big apple and the jitterbug to the *swing* music of big dance bands.

With the birth of rock 'n' roll in the mid-1950's, social dance styles became freer. Partners did not touch each other, and they made up their own dance movements on the spot. *The Twist* was the first rock 'n' roll dance to gain widespread popularity among young and middle-aged dancers alike, even though it was banned in dance halls when it was first introduced.

During the 1960's and 1970's, blacks in America created many dances that white people all over the world enthusiastically adopted. A popular style of dancing in the 1970's called "disco" rejected the "do-it-yourself" choreography of earlier rock dances. Instead, dancing partners held each other and followed a set pattern of steps. During the 1980's, young black males popularized

*break dancing*. Break dancing consists of highly stylized and vigorous acrobatic movements performed to rock music or derivatives of rock music.

**Related articles** in *World Book* include:

#### Biographies

For biographies of ballet dancers and choreographers, see the *Related articles* in the *Ballet* article. See also:

Astaire, Fred	Greco, José
Cunningham, Merce	Nikolais, Alwin
Duncan, Isadora	Saint Denis, Ruth
Dunham, Katherine	Tharp, Twyla
Graham, Martha	

#### Kinds of dances

Ballet	Folk dancing	Square dancing
Bolero	Fox trot	Tango
Cotillion	Minuet	Tarantella
Flamenco	Rumba	Waltz

#### Pictures of dancers

The following articles have pictures of dancers:

Africa	India, Dance and	Pygmies
Asia	music of	Roaring Twenties
Clothing	Indonesia	Romania
D'Amboise, Jacques	Kenya	Spain
Film industry	Latin America	Thailand
Folklore	Latvia	United States
France	Lithuania	
Gypsies	Pacific Islands	

#### Other related articles

Castanets	Musical comedy
Gymnastics (Rhythmic gymnastics)	Pantomime
Mask	Rain dance
	Rhythm

#### Outline

- I. Why people dance
- II. Kinds of dancing
  - A. Ballet
  - B. Modern dance
  - C. Folk dancing
  - D. Popular dancing
- III. Oriental dancing
- IV. African dancing
- V. The development of Western dance

#### Questions

- What is the difference between theatrical dancing and social dancing?
- What are folk dances?
- How did Isadora Duncan rebel against the ballet techniques of her time?
- What are some of the reasons that folk dances change gradually over the years?
- What were the *balli*?
- How did the birth of rock 'n' roll influence popular dance styles of the mid-1950's?
- What are some reasons why people dance?
- How and why did women's ballet costumes change during the 1700's?
- What are *mudras*?
- How do scholars know that prehistoric people danced?

**Dandelion** is a bright-yellow wild flower that grows in lawns and meadows. Throughout the temperate regions of the world, gardeners usually consider the dandelion a troublesome weed that is difficult to control.

The dandelion spread from Europe to many other parts of the world. Its name comes from the French words *dent de lion*, meaning *lion's tooth*. It has smooth





The dandelion root is long, thick, and pointed.

leaves with coarse notches, which look like teeth. The golden-yellow head is really a cluster of flowers. The dandelion has a smooth, straight, and hollow stem, and the entire plant contains a white, milky juice. The root is long, thick, and pointed, and it has hairlike root branches growing from it.

The dandelion differs from most other plants in the manner in which it reproduces. The ovaries of the dandelion form fertile seeds without having to be pollinated (see **Pollen**).

Young dandelion leaves can be used in salads or they can be cooked. They taste best when they are young, before the plant has blossomed. Wine sometimes is made from the dandelion flowers.



The dandelion is a yellow wild flower.



**Dandenong Ranges**, near Melbourne, provide a beautiful forest setting for homes.

In order to keep dandelion plants from growing on lawns, gardeners must cut deep into their roots. The roots grow to about 40 centimetres long in soft, rich earth. Slicing close under the surface only encourages the plants to grow. Gardeners sometimes spray dandelions with chemicals that destroy the dandelions but do not harm grass.

**Scientific classification.** The dandelion is a member of the composite family, Compositae. The common dandelion is *Taraxacum officinale*.

**Dandenong Ranges** are low hills about 30 kilometres east of Melbourne, Australia. The highest point in the range, Mt. Dandenong, stands 634 metres high. Other notable hills there are Barnes Lookout (625 metres) and Mt. Olinda (597 metres). The ranges have forest reserves including the Ferntree Gully National Park and Sherbrooke Forest, an excellent habitat for lyrebirds. The national park has 375 hectares and contains fern gullies and huge gum trees.

In the valleys, there is much intensive market gardening at Monbulk, Olinda, and Sassafras, where berry fruits are grown. Festivals are held to celebrate the harvests.



Commuter suburbs of Melbourne have now spread into the hills as far as Upwey and Emerald. They are served by electric trains.

Two of Melbourne's main water storage reservoirs are in the hills. Television transmitters for the city are also located in the ranges.

**Dandi march** was a walk undertaken by the Indian nationalist leader Mohandas Gandhi and his followers in 1930. On March 12, Gandhi and 78 followers began the 24 day march from Sabarmati Ashram, near Ahmadabad, through the Gujarat villages to the sea at Dandi, about 380 kilometres away. There Gandhi committed a deliberate act of civil disobedience against British rule by ceremonially breaking the law and making salt. At that time it was against the law to possess salt not made and taxed by the government. The British authorities did not arrest Gandhi immediately but imprisoned him about a month later on May 5. The Dandi march aroused enormous public interest and more than 60,000 people followed Gandhi's example during 1930 by making salt and going to prison.

**Dandie Dinmont terrier** is a dog that got its name from a book. In Sir Walter Scott's novel *Guy Mannering*, a farmer named Dandie Dinmont raised an unusual pack of short-legged terriers that were all the colour of either pepper or mustard. In the book, the dogs were famous as hunters of foxes, badgers, and otters. A new breed was later called Dandie Dinmont after the farmer in Sir Walter Scott's book.



The Dandie Dinmont terrier has short front legs.

The Dandie Dinmont terrier has a big head and large, soft brown eyes. Its forehead is covered by a silky *top-knot* (tuft of hair). Its coat is crisp to the touch on the back and soft and downy underneath. Dandies weigh between 8 and 11 kilograms and stand 20 to 28 centimetres high at the shoulders. See also **Dog** (picture: Terriers).

**Dandruff** is a condition in which flakes of dead skin are shed from the scalp. The flakes may be yellow and oily, or white and dry. The scalp normally sheds some dead skin cells. Dandruff results when it sheds thick layers of them. Doctors do not fully understand what causes the condition, and most people have it at some time. In most cases, mild dandruff can be controlled by washing the hair frequently. Dandruff does not cause baldness.

A condition called *seborrhoea* (disorder of the sebaceous glands) may produce severe dandruff and a red, itchy scalp. Dandruff shampoos containing selenium or corticosteroid hormones help treat the problem. If the condition continues, a doctor should be consulted.

**Danegeld**, meaning *Dane money*, was a land tax levied in England in the A.D. 900's and 1000's. Danish raiders often attacked England, and King Ethelred II raised the first Danegeld in 991 to buy them off. The money raised in this way continued to be paid to the Danes until 1012, when it began to be used to maintain a standing army and to improve the navy. The early Norman kings levied a similar land tax until the mid-1100's.

**Danelaw** was the area of England that the Danes occupied during and after their invasion of the 800's. The Danelaw was not a fixed area, and it shrank or grew depending on the failure or success of the Danish kings. It occupied most of northern and eastern England. Historians believe that in their northern settlements the Danes drove out or enslaved the Anglo-Saxon population. In their settlements to the south, they became landowners, and the Anglo-Saxons remained as farm workers.

**Danes**. See **Denmark**; **United Kingdom, History of** (Viking Raiders in Britain).

**Daniel, Book of**, is a book of the Bible. It is named after a Jewish hero who lived in Babylon during the early 600's and late 500's B.C. In Jewish forms of the Bible, the book is part of a collection called the *Writings*. Christian editions include it in a group called the *Prophets*.

The Book of Daniel is divided into two parts. Chapters 1-6 contain six stories that deal with historical events over a period of almost 50 years in Babylon and emphasize Daniel's loyalty to his faith. Chapters 7-12 include stories of four visions. In these visions, Daniel describes four empires that will rule the world until the triumph of God's kingdom.

In one famous story in the book (6: 1-28), Daniel is thrown into a den of lions for refusing to worship Darius the Mede as a god. The animals refuse to harm Daniel. Another story tells how Daniel interpreted mysterious handwriting that appeared during a feast held by the Babylonian ruler Belshazzar (5: 1-31). In chapter 3: 1-30, Daniel's companions Shadrach, Meshach, and Abednego are cast into a fiery furnace because they refuse to worship a golden idol. The flames do not hurt them.

Biblical scholars do not agree on the date of the book. Some once believed that Daniel was the author. Today, scholars believe the book was written much later. Many think it was written during the 100's B.C. These scholars say the author wanted to use Daniel as a heroic model to encourage Jews in a revolt against the Seleucid king Antiochus IV. The revolt was led by Judah Maccabee in the 160's B.C.

See also **Bible** (The Old Testament); **Handwriting on the wall**.

**Daniel, Glyn** (1914-1986), was a professor and historian of archaeology renowned as an expert on the prehistoric period of Britain and western Europe. He was an authority on chamber tombs and *megaliths* (large stone monuments) of the *Neolithic Era* (New Stone Age). His many publications include such books as *The Megalith Builders of Western Europe* (1958). Glyn Edmund Daniel



was born in South Wales and studied at University College, Cardiff, and St. John's College, Cambridge. He taught at St. John's College from 1938 to 1981.

**Daniel-Rops, Henri** (1901-1965), was the pen name of Henri-Jules Periot, a French author and religious historian. He gained his greatest recognition for *Jesus in His Times* (1945), a brief history of the life of Jesus Christ. His 10-volume *History of the Church of Christ* (1948-1965) traces the history of the Christian church.

Daniel-Rops was born in Épinal, France. In the 1920's and 1930's, he wrote novels and essays that radiated religious devotion and concern for humanity's loss of genuine religion. During World War II, the Nazis tried to destroy his *Sacred History* (1943), a history of the Jews. But a few copies survived, and the book was reissued after the war. In 1955, Daniel-Rops was elected to the French Academy.

**Dannay, Frederic.** See Queen, Ellery.

**D'Annunzio, Gabriele** (1863-1938), was an Italian author and political figure. His poetry deals with nature, the sea, and his own hunger for happiness. The poems show an unusual sensitivity for colours, moods, and feelings. His style is imaginative and melodious, but often flowery. D'Annunzio wrote many novels, several based on his scandalous personal life. *The Flame of Life* (1900) is based on his love affair with actress Eleonora Duse (see Duse, Eleonora). His plays include *La Gioconda* (1898) and *The Daughter of Jorio* (1904).

D'Annunzio was born in Pescara. In 1910, his extravagant living forced him to declare bankruptcy, and he moved to Paris. He returned to Italy to campaign for his country's entry into World War I. In 1919 and 1920, he served as the self-appointed ruler of the city of Fiume (now Rijeka) after seizing the city with a military force.

**Dante Alighieri** (1265-1321), an Italian author, was one of the greatest poets of the Middle Ages. His epic poem *The Divine Comedy* ranks among the finest works of world literature. Critics have praised it not only as magnificent poetry, but also for its wisdom and scholarly learning.

Dante was a great thinker and one of the most learned writers of all time. Many scholars consider *The Divine Comedy* a summary of medieval thought. Dante had a tremendous influence on later writers. Geoffrey Chaucer and John Milton imitated his works. Dante influenced such writers of the 1800's as Henry Wadsworth Longfellow, Percy Bysshe Shelley, Lord Byron, Lord Tennyson, Victor Hugo, and Friedrich Schlegel, along with T. S. Eliot in the 1900's.

**His life.** Dante was born in Florence. He received a rich education in classical and religious subjects. He may have studied at Bologna, Padua, and possibly Paris.

Dante's idealized love for a beautiful girl, Beatrice Portinari (1266-1290), provided much inspiration for his literary works. He saw her only twice, once when he was almost 9 and again nine years later. Her death at a young age left him severely grief-stricken. Sometime before 1294, Dante married Gemma Donati. They had at least three children.

Dante was active in the political and military life of Florence. He entered the army as a youth and held several important positions in the Florentine government during the 1290's. Dante became involved in a political dispute between two groups, the Guelphs and the Ghibellines, who were fighting for control of Tuscany. A political group within the Guelphs gained control of Florence in 1301. This political group was hostile to the poet and banished him in 1302, condemning him to death if he returned to Florence. Dante spent the rest of his life in exile and died in Ravenna, where he was buried.

**His works.** Among Dante's early writings, the best known is *La Vita Nuova* (*The New Life*), written about 1293. It is a collection of 31 poems with prose commentary describing his love for Beatrice. *The New Life* shows the influence of troubadour poetry, a style that flourished in southern France in the 1100's and 1200's.

Dante began *The Divine Comedy* about 1308. The poem relates his spiritual development and focuses on the theme of life after death. For more information about this work, see *Divine Comedy*.



**Daniel in the Lions' Den** was painted by the Flemish artist Peter Paul Rubens. The picture shows Daniel praying at dawn after safely spending the night in the lions' den. Completed in about 1615, it is one of the few large works Rubens painted without assistants.



Dante also wrote several nonfiction works. About 1303 and 1304 he wrote *De Vulgari Eloquentia* (*On Eloquence in the Vernacular*). This work in Latin prose stresses the importance of writing in a common Italian language, rather than in Latin or a minor dialect. Dante hoped that the Italians would develop a national literary language to help unite the country.

*Il Convivio* (*The Banquet*, 1304-1307) is an unfinished work written in Italian, consisting of three odes, each followed by long, detailed commentaries on their meaning. The work is filled with Dante's wide knowledge of philosophy and science. *The Monarchia* (*On World-Government*, 1313?) is a long essay in Latin prose. Dante called for the state, in the form of the Holy Roman Empire, to join with the church in guiding people to a better life on earth and joy in heaven. Other works include a group of poems and several letters.

See also **Allegory**; **Virgil** (His influence).

**Danton, Georges Jacques** (1759-1794), was a great leader of the French Revolution. His policy was "boldness, and more boldness, and ever more boldness, and France is saved!" He perhaps did more to create and defend the French Republic than any other person. Danton was partly responsible for the massacres of the Reign of Terror, which he considered necessary for the safety of his country. When he believed that safety was assured, he advocated more humane policies. He wished to restore, rather than to destroy, the normal life of France.

Danton was born in Arcissur-Aube, of middle-class parents. At the beginning of the revolution he was a successful lawyer in Paris, and a leader of the Cordeliers Club, one of the militant factions of the extreme Republicans. This group favoured ridding France of the monarchy. They achieved their purpose on Aug. 10, 1792, when they forced the legislative assembly to imprison Louis XVI. Danton, who is called "the Man of August 10th" because of his leadership in the movement to imprison Louis XVI, became minister of justice.

Danton and his associates, Camille Desmoulins, Maximilien Robespierre, and Jean Paul Marat, established a national convention of revolutionary leaders and a revolutionary tribunal. These two bodies ruled France for the next three years. Almost anyone could be brought before the jury of the tribunal. Their victims were not only traitors, but also persons suspected of being too mild in their political views. Danton and Desmoulins soon recognized the need for stamping out this violence. They felt that the convention should relax its policy and prepare a workable republican constitution for an orderly government. Danton suggested halting the violence.

Robespierre was jealous of Danton's success. He ordered Danton arrested for disloyalty and brought before the tribunal. Danton's fiery and eloquent denunciation alarmed the tribunal members, who feared loss of power. Danton was condemned and executed. His execution climaxed the Reign of Terror.

See also **French Revolution**; **Marat, Jean Paul**; **Robespierre**.

**Danube River** is the second longest river in Europe. Only the Volga River is longer. The Danube flows 2,860 kilometres from its source in Germany to its mouth at the Black Sea in eastern Europe.

The Danube begins at the merger of two small rivers in the Black Forest in Germany. The river winds east



Location of the Danube River

through Germany and Austria, and along part of the border between Slovakia and Hungary. It curves south near Budapest, Hungary. The river flows through Hungary and then forms part of the border between Croatia and Yugoslavia. It turns east and flows across Yugoslavia. The river then forms part of the border between Yugoslavia and Romania and most of the border between Romania and Bulgaria. It flows north through Romania, then east to form part of the border between Romania and Ukraine. The river then splits into three branches before emptying into the Black Sea. The northernmost branch forms the rest of the border between Romania and Ukraine.

Commercial ships and barges transport large amounts of freight on the Danube. They carry agricultural goods, chemicals, mineral ores, steel, and other products. About 35 major ports lie along the Danube.

Several countries have dams and electric power plants on the Danube. The largest dam is the Iron Gate Dam. It stands at the Iron Gate, a gorge at the border between Yugoslavia and Romania. The dam's power plant produces electricity for Romania and Yugoslavia.

Many canals connect the Danube to other waterways. The Main-Danube Canal, opened in September 1992, connects the Danube to the Main River, which is a branch of the Rhine River. This canal makes it possible for ships to travel between the Black and North seas.

The beauty of the Danube River inspired the Austrian composer Johann Strauss, Jr., to write the famous waltz "On the Beautiful Blue Danube." Today, however, the river is highly polluted.

**Danzig.** See **Gdańsk**.

**Daoism.** See **Taoism**.

**Daoud Khan, Muhammad.** See **Afghanistan**.

**Daphne** was a nymph in Greek mythology. She was the daughter of a river god, either Ladon or Peneus. The best-known myth about Daphne recounts her flight from the god Apollo. The god Eros shot both Daphne and Apollo with arrows in revenge against Apollo for insulting his skill as an archer. Eros shot Apollo with a gold-tipped arrow, causing him to fall madly in love with Daphne. He shot the nymph with a leaden one, making her hate all suitors. Apollo pursued Daphne relentlessly.



One day, when he was finally about to catch her, Daphne prayed for escape, and was transformed into a laurel tree. Although Apollo could not possess her, he made the laurel his sacred tree and wore a crown of laurel leaves on his head. See **Apollo**; **Cupid**.

**Daphne**, a plant. See **Poisonous plant** (table).

**Daphnia**. See **Water flea**.

**Dar es Salaam** (pop. 870,020) is the capital and largest city of Tanzania, and a chief seaport in eastern Africa. The city lies on the east coast of Tanzania, which borders the Indian Ocean. For location, see **Tanzania** (map).

Dar es Salaam is a major transportation centre. It has an international airport and a large port, and railways and highways link it with the rest of the mainland of Tanzania. The city also has many churches, libraries, and research centres. The University of Dar es Salaam, the National Art Gallery, and the National Museum of Tanzania are in the city.

Foreign trade plays a key role in the economy of Dar es Salaam. Large quantities of imported and exported goods pass through the city's port. Products manufactured in Dar es Salaam include cigarettes, footwear, furniture, soft drinks, and textiles.

The sultan of Zanzibar, the ruler of a nearby island, founded Dar es Salaam in 1862 as a trading post. Germany took control of the city in 1887 and made it a major trading centre for eastern Africa. British forces captured the city in 1916, during World War I. It became the capital of Britain's Tanganyika Territory in 1919. Tanganyika gained independence from Britain in 1961 and became part of Tanzania in 1964.

Since 1964, the population of Dar es Salaam has increased from about 150,000 to about 870,000. In 1973, Tanzanians voted to move the capital from Dar es Salaam to the inland city of Dodoma. The move was expected to be completed in the 1990's.

See also **Tanzania** (picture).

**Darby, Abraham** (1677-1717), revolutionized the casting of iron. His greatest achievement was to use coke in-

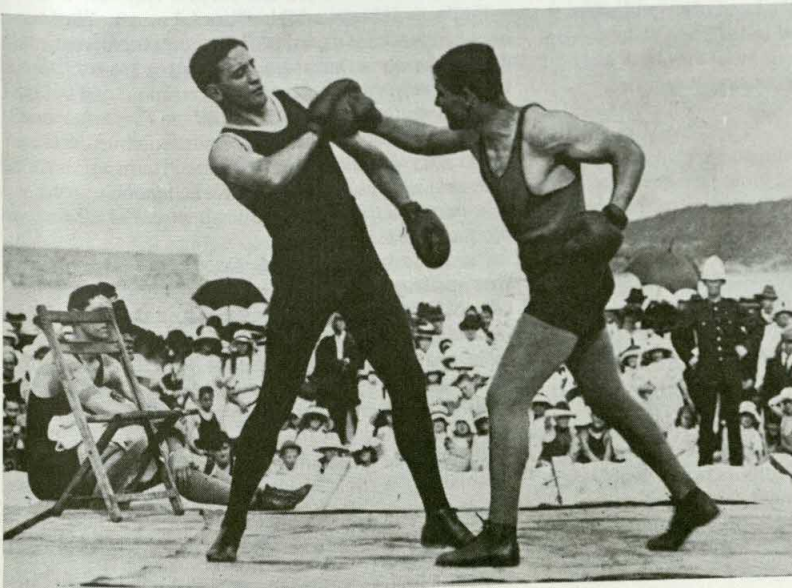
stead of charcoal for smelting. He built bigger and more powerful blast furnaces at his ironworks at Coalbrookdale, in Shropshire, and introduced a better method of casting iron, using sand instead of loam. Darby was born at Dudley, in West Midlands. He was a Quaker. After his apprenticeship in Birmingham, he went to work at a Bristol brassworks.

**Darcy, Les** (1895-1917), was an Australian boxer. Between 1910 and 1916, he won all but 4 of his 50 fights. He was born at Stradbroke, in New South Wales. His full name was James Leslie Darcy. He won the Australian middleweight title in 1915 and heavyweight title in 1916. Jimmy Clabby was among the world-ranking boxers that Darcy defeated.

**Dardanelles** is a strait that joins the Aegean Sea with the Sea of Marmara. The strait is part of a waterway that leads from the landlocked Black Sea to the Mediterranean. Also part of this waterway is the Bosphorus, a strait joining the Black Sea and the Sea of Marmara. The word *Dardanelles* comes from the ancient Greek city of Dardanus, on Asia's side of the strait. The ancient Greeks called this strait the *Hellespont*.

At its narrowest point, the Dardanelles is about 1.5 kilometres wide from the European shore to the Asiatic. The average width of the strait is 5 to 6 kilometres. It is about 60 kilometres long, and the average depth is 60 metres. The Dardanelles usually has a strong surface current in the direction of the Aegean Sea, but a powerful undercurrent flows east and carries salty water through the Sea of Marmara and the Bosphorus into the Black Sea. This undercurrent keeps the Black Sea from becoming a freshwater body.

In 480 B.C., Xerxes I of Persia built a bridge of boats across the Dardanelles near Abydos and led an army over it to invade Europe. In 334 B.C., the Macedonian general Alexander the Great led his army over a similar bridge across the Dardanelles into Asia. Hundreds of years later, the strait was important to the defence of the Byzantine Empire. After that empire fell, the Ottoman



**Les Darcy**, boxing at right, won the Australian middleweight title in 1915 and the heavyweight title in 1916. The world middleweight title was in dispute. Darcy won several bouts billed as world middleweight title fights, but these contests did not win universal recognition.





The Dardanelles lies between Europe and Asia.

Turks ruled the Dardanelles. See **Byzantine Empire**.

In 1841, the great powers of Europe—Great Britain, France, Prussia, and Austria—agreed to give Turkey control of the passage of ships through the Dardanelles. During World War I (1914-1918) several battles were fought over control of the Dardanelles. The Treaty of Lausanne in 1923 opened the Dardanelles to all nations. In 1936, the Montreux convention gave Turkey permission to remilitarize the strait.

Early in World War II, the strait was closed to all ships except those with special permission from Turkey. During the war, Turkey kept control of this important waterway. After World War II, the Soviet Union unsuccessfully attempted to gain control of the Dardanelles. The Western Powers supported Turkey's rights to the strategic strait.

**Related articles** in *World Book* include:

Aegean Sea	Hellespont	World War I (The
Black Sea	Marmara, Sea of	Dardanelles)
Bosphorus	Turkey	

**Dare, Virginia** (1587- ? ), was the first English child born in America. Her parents were Ananias Dare and Eleanor White, two members of a band of 117 colonists who settled on Roanoke Island in 1587. She was born on August 18 and named Virginia in what may have been the first English christening ceremony in America.

See also **Lost Colony**.

**Dargie, Sir William** (1912- ), an Australian artist known especially for his realistic portraits, won the Archibald Prize for portraits eight times (see **Archibald Prize**). The Australian government commissioned him to paint several portraits, including that of Queen Elizabeth II, in 1954. During World War II, Dargie became official war artist with the Australian military forces. William Alexander Dargie was born in Melbourne and trained as a schoolteacher. He became a full-time painter in 1936. He directed the art school of the National Gallery of Victoria from 1946 to 1953.

**Darío, Rubén** (1867-1916), was the pen name of Félix Rubén García Sarmiento, one of the most important poets to write in Spanish. Darío was the outstanding figure among Spanish-language authors whose work is associated with a literary movement called *modernism*.

A collection of verse and prose called *Azul* . . . (1888) established Darío's reputation. The verse brought a new rhythmic beauty to literary Spanish. Considered even

more innovative are the short prose selections, which stress description over narration and sensory appeal over statement. In *Wandering Song* (1907), Darío moved toward poetry that responded more directly to common human problems.

Darío was born in Metapa (now Ciudad Darío), Nicaragua. He held several diplomatic posts, including Nicaraguan consul in Paris and minister to Brazil and Spain.

See also **Latin-American literature** (Modernism).

**Darius I** (550?-486 B.C.) ruled the Persian Empire from 522 B.C. until his death. He is often called Darius the Great. Darius extended the Persian Empire, which was based in southwest Asia, eastward into what is now southern Pakistan and westward into southeastern Europe. He tried to conquer Greece, but failed.

In 522 B.C., Darius' assistant and half brother Artaphrenes murdered King Bardiya of Persia. Darius then seized the throne. Armies led by Darius put down a rebellion in Egypt in 519 B.C. and conquered Thrace in southeastern Europe about 513 B.C. A few years later, Persian forces conquered what is now southern Pakistan. Darius efficiently ruled his vast empire by dividing it into 20 large *satrapies* (provinces). The officials he chose to govern the satrapies raised taxes locally for the royal treasuries and provided Darius with soldiers.

During the 490's B.C., Greeks in Asia Minor (now Turkey) rebelled unsuccessfully against Persian rule. In 492 B.C., a Persian attempt to invade Greece failed. In 490 B.C., Darius sent another expedition to conquer Greece. The army landed northeast of Athens on the plain of Marathon. The Greeks, though outnumbered, defeated the Persians (see **Marathon**). Darius died before he could organize another invasion of Greece. His son Xerxes I succeeded him.

**Darius III** (380?-330 B.C.) was the last of the Achaemenid kings of Persia. This family had developed one of the world's greatest empires in western Asia during the 500's B.C. Darius tried to prevent Alexander the Great, the king of Macedonia, from conquering the Persian Empire, but failed.

Ineffective kings and rebellions by provincial governors had weakened the Persian Empire for almost a hundred years when Darius became king in 336 B.C. He tried to reorganize the central government and build a strong army. In 333 B.C., Alexander the Great defeated Darius' forces at Issus in what is now southern Turkey. In 331 B.C., Alexander again defeated Darius in the Battle of Arbela, also called the Battle of Gaugamela, in what is now northern Iraq. Darius was murdered by his own nobles in 330 B.C.

See also **Alexander the Great**.

**Darjeeling** (pop. 57,603) is the summer capital of the state of West Bengal and the administrative centre of the Darjeeling district. It lies north of Calcutta in eastern India, near the border with Nepal. The city is also sometimes called Darjiling and its name comes from the Tibetan words *Dorje Ling*, which mean "place of thunder-bols."

The city lies on a series of terraces on a ridge in the foothills of the Himalaya. It stands at about 2,160 metres above sea level. The high altitude makes the city cool and pleasant throughout the year, with average temperatures ranging from 4° C in January to 17° C in July. The city has a high average annual rainfall of more than



3,000 centimetres. Most of the rainfall occurs in the summer, especially between June and September, when mists and clouds often shroud Darjeeling and the surrounding areas. People who live in the Indian lowlands seek relief from the heat by staying at one of Darjeeling's resort hotels in September and October. In the mostly dry winter months, visitors to Darjeeling enjoy superb views of green valleys and snowcapped peaks. Mount Kanchenjunga can be seen from the city. Mount Everest is visible from just outside the city.

The well-known Darjeeling tea grows on hillsides near the city. A small, narrow-gauge railway climbs to the city from the plains over steep slopes and through tea plantations and forests of teak. A wide square serves as an open-air bazaar for trading. The city contains the University of North Bengal, which was founded in 1962. The British made Darjeeling the summer capital of the Bengal region in the 1800's.

**Dark Ages** is a term once used to describe the early centuries of the Middle Ages, from the A.D. 400's to the 900's. The word *dark* referred to a supposed lack of learning during the period. We know now that the Middle Ages were not completely "dark." The period only seemed dark to scholars of the more advanced Renaissance and to historians later influenced by them.

From the 400's, civilization sank low in western Europe. Knowledge from the ancient Romans survived only in a few monastery, cathedral, and palace schools. Knowledge acquired from ancient Greece almost disappeared. Few people received schooling. Many of the ancient artistic and technical skills were lost. In their ignorance, writers accepted popular stories and rumours as true. In the early 1000's, economic and political life began to revive in western Europe.

While such darkness existed in western Europe, life was brighter elsewhere. The Byzantine Empire preserved many features of Greek and Roman life (see **Byzantine Empire**). The Arabs spread a splendid civilization from Spain to the borders of China (see **Muslims**).

For a description of life and culture of the Dark Ages, see **Middle Ages; Feudalism; Renaissance**.

**Dark matter** is the invisible substance that makes up most of the mass of galaxies and clusters of galaxies. Dark matter is unlike other forms of matter because it does not give off, reflect, or absorb light. Observations suggest that the mass of the universe consists of at least 10 times more dark matter than visible matter.

Strong evidence of dark matter comes from measurements of orbital speeds of stars and gas clouds in spiral galaxies. Calculations based on these measurements indicate that the amount of matter in the galaxies is larger than the visible mass. Similarly, most matter in clusters of galaxies is dark. Astronomers confirmed the large amount of dark matter in clusters by measuring arcs of light found in images of certain clusters. Astronomers used the arcs to calculate the mass of the clusters.

Scientists are not sure of the composition of dark matter. One theory suggests it is some type of ordinary matter known as *massive astrophysical compact halo objects* (MACHO's). One type of MACHO might be isolated planet-sized gas balls called *jupiters* that are too small to shine as stars. But many astronomers argue it is unlikely that so many jupiters could have formed. Astronomers have not found any MACHO's.

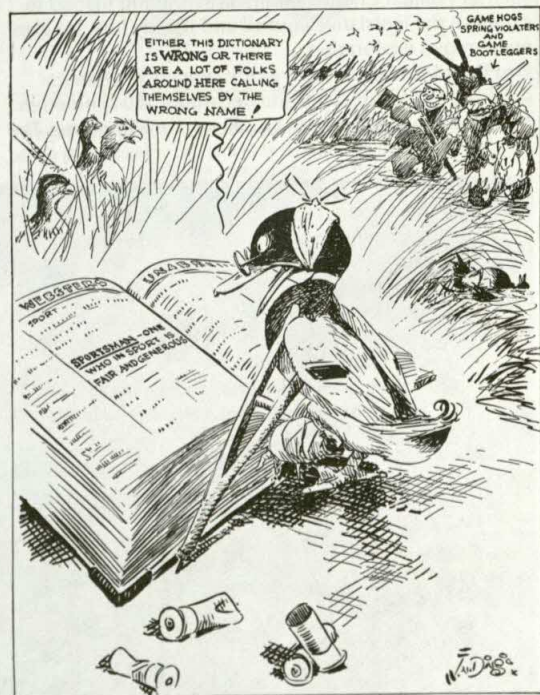
Another possibility is that dark matter consists of subatomic particles called *neutrinos*. Scientists do not know whether these particles have any mass. If neutrinos contribute significant mass to the universe, they would be known as "hot dark matter." In the early universe, when galaxies began to form, such neutrinos would have been travelling at almost the speed of light.

According to a third theory, dark matter could be "cold," consisting of hypothetical particles that moved much more slowly than light in the early universe. Such particles might be *weakly interacting massive particles* (WIMP's), whose mass would be much larger than that of a proton; or *axions*, which would be much less massive than an electron. See **Atom** (The parts of an atom).

**Darling, Ding** (1876-1962), was an American editorial cartoonist. During the Great Depression of the 1930's, his work often ridiculed the relief programmes of President Franklin D. Roosevelt. Darling also took a strong interest in the conservation of natural resources. Many of his cartoons criticize those who threaten wildlife. Darling won the Pulitzer Prize for cartooning in 1924 and 1943.

Jay Norwood Darling was born in Norwood, Michigan, and was nicknamed Ding while a student at Beloit College. He became a cartoonist for the *Sioux City* (Iowa) *Journal* in 1901 and joined the *Des Moines Register* in 1906. From 1917 until 1949, the *New York Tribune* (later called the *Herald Tribune*) distributed his cartoons to other U.S. newspapers. In 1934 and 1935, he served as chief of the U.S. Bureau of Biological Survey.

**Darling, Grace Horsley** (1815-1842), became a famous English heroine by helping save nine survivors of



"Why Call Them Sportsmen?" Through his cartoons, Ding Darling fought for the conservation of wildlife in America.



**The Darling** is Australia's longest river. From its source in the Great Dividing Range, it flows 2,740 kilometres to Wentworth, where it joins the Murray River.



a shipwreck. She lived at Longstone Lighthouse on one of the Farne Islands, off the English coast. Her father was keeper of the lighthouse. The steamer *Forfarshire* was wrecked on Sept. 7, 1838. Through a telescope, she saw several people clinging to a rock. During a storm, she rowed to the rescue with her father. The Humane Society awarded both of them gold medals. She was born in Bamborough, Northumberland.

**Darling, John** (1852-1914), a South Australian wheat merchant, was chairman of the Broken Hill Proprietary Company from 1907 to 1914. Darling worked closely with the company's general manager, G. D. Gelpratt, to set up Australia's first steelworks, at Newcastle. He was born in Edinburgh, Scotland.

**Darling, Sir Ralph** (1775-1858), was governor of New South Wales from 1825 to 1831. He governed the colony firmly, coming into conflict with people of liberal views, such as William Charles Wentworth. Darling helped to establish the legislative council and trial by jury. He also encouraged exploration.

**Darling Downs**, known as the *granary of Queensland*, is a fertile tableland situated about 160 kilometres west of Brisbane. It covers 21,200 square kilometres. The

Condamine River and its tributaries flow through the region, irrigating lush farmlands. Major products from this area include wheat, sorghum, cereals, dairy produce, meat, fruit, and vegetables. The Darling Downs is one of the most densely populated parts of Queensland. More than 100,000 people live in the area.

**Darling River** is the longest river in Australia. It flows 2,740 kilometres and drains more than 650,000 square kilometres of land.

The Darling rises in the Great Dividing Range in the state of Queensland, in eastern Australia, and flows southwest across the state of New South Wales. Near the town of Wentworth, it flows into the Murray River, which empties into the Indian Ocean. In winter, the Darling is dry along most of its course. But in summer, it is an important source of water for the Murray. See *Australia* (terrain map; Rivers); *Murray River*.

During the 1800's, the Darling served as an important waterway for barges and steamboats. Today, the river is important chiefly as a source of water for livestock and crops.

**Darling Scarp** is a chain of mountains in Western Australia. It lies east of Perth and runs almost parallel to



**The Darling Downs** produces most of Queensland's grain. Toowoomba is the largest city in the region. In 1827, the explorer Allan Cunningham became the first European to visit the Darling Downs. In 1840, the first settlers established sheep stations in the area.



the west coast. Its highest peaks are Mt. Cooke (582 metres) and Mt. Solus (557 metres).

**Darlington** (pop. 96,700) is a local government district and the largest town in the county of Durham, England. The town stands on the River Skerne about 27 kilometres south of Durham. Darlington is an industrial centre. It has various engineering works, steel mills, textile mills, and electrical equipment factories. George Stephenson's first steam engine, *Locomotion*, which ran on the Stockton and Darlington Railway, is kept at North Road Railway Station Museum. See **Durham**.

**Darnley, Lord** (1545-1567), Henry Stuart, a Scottish nobleman, was close in the line of succession to the throne of England. Darnley was a feeble, degenerate man. He married Mary, Queen of Scots, in 1565, but soon alienated his wife and became extremely unpopular with the Scottish noblemen. They persuaded him to join them in a successful plot to assassinate David Rizzio, Mary's favourite adviser, in 1566. The following year Darnley himself was assassinated. Mary was probably involved in his death, together with her new favourite, the Earl of Bothwell (see **Bothwell, Earl of**).

Darnley was born at Temple Newsam, in West Yorkshire. He and Mary had one child, James, who became James VI of Scotland and, later, James I of England.

**Darrow, Clarence Seward** (1857-1938), was the most famous American lawyer of the early 1900's. He was clever and eloquent, and earned a worldwide reputation as a brilliant criminal defence attorney.

Darrow was born in Kinsman, near Youngstown, Ohio. He studied law for a year at the University of Michigan and began practising law in Ohio in the early 1880's. Darrow moved to Chicago in 1887 and later worked as an attorney for the city of Chicago and the Chicago & North Western Railway. Darrow represented Eugene V. Debs and other officials of the American Railway Union who were arrested for supporting the Pullman strike of 1894, which disrupted mail delivery. This case made him famous as a defender of union interests.

Darrow became active as a defence attorney for trade unions and served in the Illinois House of Representatives from 1903 to 1905. In 1911, Darrow went to Los Angeles to defend John J. and James B. McNamara. The brothers, both union leaders, were charged with dynamiting the Los Angeles Times Building. Darrow had the McNamaras plead guilty and saved them from a probable death sentence. But he lost union support forever.

Darrow returned to Chicago and started to specialize in criminal cases. He was nearly 70 years old when he tried his two most spectacular cases. In 1924, Darrow defended Nathan F. Leopold, Jr., and Richard A. Loeb, who admitted kidnapping and murdering 14-year-old Bobby Franks in an attempt to commit a perfect crime. Darrow used psychiatric evidence and argued that the 19-year-old Leopold and 18-year-old Loeb were mentally ill. Darrow's goal was to keep the youths from receiving the death sentence, which he strongly opposed. Leopold and Loeb each received a sentence of life imprisonment plus 99 years.

In 1925, Darrow helped attract widespread attention to the Scopes trial in Dayton, Tennessee. In this case, he defended the right of John T. Scopes to teach the theory of evolution in a state school.

See also **Scopes trial**.

**Dart.** See **Darts**.

**Dart, Raymond** (1893-1988), was an Australian-born South African *anthropologist* (person who studies human beings scientifically). He was the first to suggest that the earliest ancestors of humans lived in Africa. In 1925, Dart announced that a skull of a three-year-old creature found in Taung, Botswana, was more like a human being than any other apes. He named it *Australopithecus africanus* (southern ape of Africa).

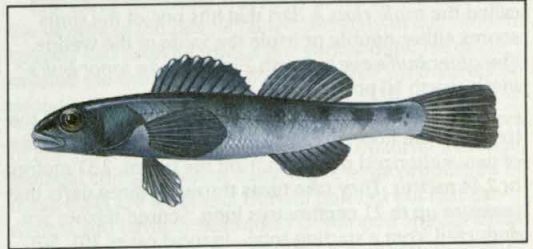
Raymond Arthur Dart was born in Brisbane, Queensland, Australia. For 36 years he was professor of anatomy at Witwatersrand University, South Africa, where he was also dean of the medical school.

See also **Australopithecus**; **Prehistoric people**.

**Darter.** See **Anhinga**.

**Darter** is any of about 140 species of small freshwater fish belonging to the perch family. Darters are found in North American waters east of the Rocky Mountains, from central Canada to northern Mexico. The fish gets its name from the way it darts from place to place.

Most darters live in clear, fast-moving streams that have gravelly bottoms. Others thrive in lakes and rivers. During the breeding season, male darters of many species develop brilliant colours. Male *rainbow darters*, which become blue, red, and yellow, are especially striking. Female darters lay eggs in spring or early sum-



**The Johnny darter**, like other darters, is a small freshwater fish of the perch family. The fish gets its name from the way it swims, darting quickly from one resting place to another.

mer. Darters eat a variety of water insects and other fish. The young feed on microscopic organisms called *zooplankton*. Darters range in size from the *least darter*, which measures less than 5 centimetres long, to the *freckled darter* and the *logperch*, which grow nearly 20 centimetres long. Most species measure from 5 to 10 centimetres.

Several species of darters have become endangered because the fish are particularly sensitive to changes in their environment. Concern over the *snail darter* delayed completion of the Tellico Dam on the Little Tennessee River during the late 1970's. The dam, which was completed in 1980, destroyed what was then the only known habitat of the snail darter. However, the species was later discovered in a few other Tennessee streams and is no longer considered endangered.

**Scientific classification.** Darters belong to the freshwater perch family, Percidae. The snail darter is *Percina tanasi*.

See also **Fish** (picture: Fish of temperate fresh waters). **Dartford** (pop. 78,400) is a local government district in Kent, England, between the River Thames and the North Downs. Its population is concentrated in the north, where industries include engineering and the manufac-



ture of bricks, cement, paper, and pharmaceuticals. The south of the district is mainly rural. Dartford town is the district's administrative centre.

See also **Kent**.

**Dartmoor** is a rocky plateau in Devon in southwestern England. It covers about 906 square kilometres. Dartmoor has many granite peaks, called *tors*. The loftiest tor, High Willhays, rises to a height of 621 metres. The Dartmoor area is a National Park. Princetown is the site of Dartmoor Prison, one of the United Kingdom's top security prisons. See **Devon**.

**Dartmouth Dam** is Australia's largest dam. It is an earth-rockfill dam located on the Mitta-Mitta River in northeastern Victoria. It is 180 metres high and has a capacity of 4 billion cubic metres. The dam supplements the water supplies of Lake Hume, provides flood control in the Upper Murray system, and helps decrease the salinity problems of the River Murray. It also provides electric power for Victoria. The dam cost 119 million Australian dollars to build. It was completed in 1977.

**Darts** is a game in which the players throw darts at a target called a *dartboard*. A regulation dartboard measures about 46 centimetres in diameter. It is divided into 20 equal-sized areas shaped like wedges of a pie. A player scores from 1 to 20 points by hitting different wedges. The board is further divided by a narrow outer ring called the *double ring* and a narrow inner ring called the *triple ring*. A dart that hits one of the rings scores either double or triple the value of the wedge. The *outer bull's-eye* is worth 25 points. An *inner bull's-eye* is worth 50 points.

The dartboard is mounted so the bull's-eye is 1.73 metres from the floor. In tournaments, players stand at one of two authorized distances from the board, 2.37 metres or 2.44 metres. They take turns throwing three darts that measure up to 21 centimetres long. Scored throws are deducted from a starting total—in most cases 301, 501,

1001, or 3001. The winner must start and end the game by hitting the double ring or the inner bull's-eye.

Other games can be played with darts. In "Cricket" one team "bats," scoring as many as possible, while the "bowling" team takes wickets by scoring inner bull's-eyes. "Round-the-Clock" is for individual players. Each player must throw a dart into each numbered sector in order.

People play darts in about 80 countries. The game began in the United Kingdom (UK), where it is one of the most popular indoor games. It is played in many public houses (pubs). There are about 7,000 men's darts clubs in the UK and 400 women's clubs.

The game of darts dates from the Middle Ages. It began as an open-air game, in which archers threw hand arrows at a target. Later, the target was replaced by a section of tree trunk, and the game became an indoor one. Darts was very popular during the 1500's and 1600's. It travelled to America with the first colonists.

Medieval archers used hand arrows about 25 centimetres long. The much shorter modern darts, now usually made of metal and plastic, came into use in the late 1800's.

**Darwin** (pop. 78,139) is the administrative centre and capital of Australia's Northern Territory. It is an important terminus of road, sea, air, and telecommunications. Darwin also has a large military base with airfields and a naval port. Darwin is probably the most cosmopolitan city in Australia. Most of its people are of European descent. But many citizens have Aboriginal, Chinese, Malay, or Filipino ancestry.

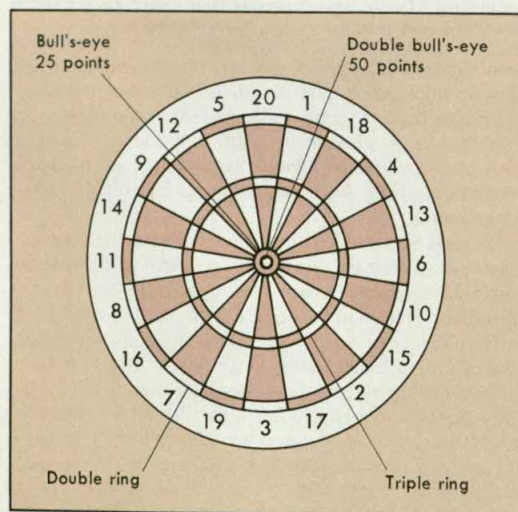
Darwin receives nearly all its annual rainfall of 1,632 millimetres between late December and early March. Its dry season of mild, pleasant days extends from May until September. The remaining months are hot, humid, and thundery.

Most of Darwin's work force is employed in public services, in the defence forces, in professional work, in business, or in the building, transport, and communications industries. Darwin is the main deepwater port in the Northern Territory. It imports general goods and petroleum products, and exports cattle, animal hides, and minerals. Secondary industries include an abattoir. Buffalo meat is also processed and exported.

The Stuart Highway links Darwin with Alice Springs, 1,600 kilometres to the south. The Barkly Highway, which runs from the east through Mount Isa and Camooweal, joins the Stuart Highway near Tennant Creek. The Victoria Highway, which also joins the Stuart Highway near Katherine, links Darwin with Western Australia.

Darwin's harbour was first sighted in 1839 by John Lort Stokes of H.M.S. *Beagle*. The ship's captain, John Clements Wickham, named the port in honour of Charles Darwin, the British naturalist, who had sailed with him in 1833-1836, on an earlier expedition of the *Beagle*.

South Australia originally governed the Northern Territory. On Feb. 5, 1869, G. W. Goyder, the South Australian surveyor general, established a small settlement of 135 men and women at Port Darwin. Goyder named the settlement Palmerston, after the British prime minister Lord Palmerston. In 1870, the first poles for the Overland Telegraph were erected. The discovery of gold at Pine



**Darts** is a game in which the players try to score points by throwing darts at a target. The target is divided into wedge-shaped areas. The wedges are worth from 1 to 20 points. A dart that lands in a ring scores double or triple the wedge's value.





**Darwin** is the capital of Australia's Northern Territory. It is also the main deepwater port of the Northern Territory.

Creek in the 1880's further boosted the young colony's development. The Australian federal government assumed control of the Northern Territory in 1911, and Darwin became the city's official name. In 1957, the people of Darwin gained control of their own local government.

On Dec. 25, 1974, Cyclone Tracy devastated Darwin killing 50 people and damaging more than 11,000 homes. After the disaster, an airlift evacuated 30,000 people. The Darwin Reconstruction Commission rebuilt the city, during the late 1970's. A satellite city of Palmerston was built 20 kilometres south of Darwin in the early 1980's.

See also Northern Territory.

**Darwin, Charles Robert** (1809-1882), was a British naturalist who became famous for his theories on evolution. Like several other scientists before him, Darwin believed that, through millions of years, all species of plants and animals had *evolved* (developed gradually) from a few common ancestors.

Darwin's theories included several related ideas. They were: (1) that evolution had occurred; (2) that most evolutionary change was gradual, taking place over thousands or millions of years; (3) that the primary mechanism for evolution was a process called natural selection, and (4) that the millions of species present on earth today arose from a single original life form through a branching process called speciation, by which one species can give rise to two or more species. Darwin set forth his theories in his book *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (1859).

Darwin's theories shocked most people of his day, who believed that each species had been created by a separate divine act. His book, which is usually called simply *The Origin of Species*, presented facts that refuted this belief. It caused a revolution in biological science and greatly affected religious thought.

**Darwin's life.** Darwin was born in Shrewsbury, England. He was the grandson of the noted doctor and natu-

ralist Erasmus Darwin, who had proposed a theory of evolution in the 1790's. As a boy, Charles often heard his grandfather's theories discussed.

Darwin studied medicine at the University of Edinburgh and theology at Cambridge University. He received a bachelor's degree from Cambridge in 1831. From 1831 to 1836, Darwin served as a naturalist with a British scientific expedition aboard H.M.S. *Beagle*. The expedition visited places throughout the world, and he studied plants and animals everywhere it went.

In South America, Darwin found fossils of extinct animals that closely resembled modern species. On the Galapagos Islands in the Pacific Ocean, he noticed many variations among plants and animals of the same general type as those in South America. He collected fossils and other specimens of organisms for future study.

Darwin returned to England in 1836 and settled in London. He spent the rest of his life studying specimens, doing experiments, corresponding with other scientists, and writing about his findings. His early books included *The Structure and Distribution of Coral Reefs* (1842) and a journal of his research aboard the *Beagle*.

In 1839, Darwin married his cousin Emma Wedgwood. The family moved to Downe, near Croydon, in 1842, and Darwin lived there until his death. He was buried in Westminster Abbey in London.

**Darwin's theories.** The study of the specimens from the voyage of the *Beagle* convinced Darwin that modern species had evolved from a few earlier ones. He documented the evidence and first presented his theories on evolution to a meeting of scientists in 1858.

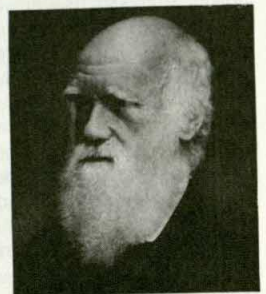
In most cases, according to Darwin, no two members of any species are exactly alike. Each organism has an individual combination of traits, and a large proportion of these traits are inherited. Darwin pointed out that gardeners and farmers commonly developed special kinds of plants and animals by selecting and breeding organisms that had desired traits. He believed that a similar kind of selective process took place continuously in nature. Darwin called this process *natural selection*. Others have called it *the survival of the fittest*.

Darwin showed that living things commonly produce many more offspring than are necessary to replace themselves. The earth cannot possibly support all these organisms, and so they must compete for such necessities as food and shelter.

Their lives also are threatened by animals that prey on them, by unfavourable weather, and by other environmental conditions. Darwin referred to this everlasting competition as the struggle for life.

Darwin suggested that some members of a species have traits that aid them in this struggle for life. Other members of the species have less favourable traits and therefore

are less likely to survive or reproduce. On average, the members with favourable traits live longer and produce more offspring than do the others.



**Charles Darwin**



They also pass on the favourable traits to their young. The unfavourable traits are eventually eliminated. When this process occurs in two geographically isolated populations of one species, members of one of the populations may become so different genetically that they will be regarded as belonging to a separate species.

Darwin wrote several books that further discussed his theories of evolution. These included *The Descent of Man and Selection in Relation to Sex* (1871) and *The Expression of the Emotions in Man and Animals* (1872).

**The influence of Darwin's ideas.** Darwin's theories of evolution through natural selection set off a bitter controversy among biologists, religious leaders, and the general public. Many people thought Darwin had implied that human beings were descended from monkeys, and they angrily criticized his revolutionary ideas. But such noted British scientists as Thomas Henry Huxley and Alfred Russel Wallace supported Darwin's work, and almost all scientists eventually accepted his theories. These theories, and the facts that supported them, gave biologists new insight into the origin of living things and the relationship among various species.

Darwin's theory of evolution by natural selection stimulated studies in biology, particularly in palaeontology and comparative anatomy. During the first half of the 1900's, discoveries in genetics and developmental biology were used as evidence for theories of evolution that regarded natural selection as unimportant. However, after World War II ended in 1945, Darwin's theories again became the dominant influence in evolutionary biology in a form often called *Neo-Darwinism*. Neo-Darwinism gave a fuller explanation for the genetic origin of variation within individual species and for how species are formed. Few biologists reject the basic propositions of Neo-Darwinism, and Darwin's theories continue to be the basis for many contemporary biological studies.

Darwin's work has had a tremendous impact on religious thought. Many people strongly oppose the idea of evolution—and the teaching of it—because it conflicts with their religious beliefs. For example, they claim that the theory of evolution disagrees with the Biblical account of the Creation. Some people argue against the theory of natural selection because they believe it diminishes the role of God in the universe.

Darwin avoided discussing the theological and sociological aspects of his work, but other writers used his ideas in their own theories about society. The German philosopher Karl Marx compared the struggle for survival among organisms to the struggle for power among social classes. Certain other writers referred to natural selection to justify the concept of the development of superior races of human beings. Scholars called social Darwinists used Darwin's ideas to promote the belief that people in a society—and societies themselves—must compete for survival.

See also **Evolution; Natural selection; Social Darwinism.**

**Dasheen.** See Taro.

**Dasyure.** See Marsupial cat.

**Data processing.** See Computer.

**Data protection** is the safeguarding of electronic information stored in computers. Data protection includes: (1) the legal safeguards of people's rights to see

what information may be held about them in a computer database, and (2) the protection from theft, destruction, or damage of *software* (programs) and data held in a computer's memory. The second type of data protection is also often called *data security*.

**Safeguarding rights.** Many government departments and commercial companies have computers that hold *personal data* (information about individuals). For example, a company may have a computer database listing the names and addresses of past customers. A tax office may have a similar computerized list of everyone who pays income tax. Some countries have laws giving various rights to people listed in such databases. In the United Kingdom (UK), the 1984 Data Protection Act safeguards an individual's right to see his or her database entry, alter inaccuracies, or in some cases have it erased. Organizations holding computerized personal data must register with the Data Protection Registrar. The act does not normally apply to someone using a home computer to keep the names and addresses of family members or friends, or to a club or society that keeps its membership list on a computer database.

Except in a few cases, organizations registered with the Data Protection Registrar must show any individual whatever information they hold on that person. Any organization that should register but does not is committing a criminal offence. Similar laws operate in other countries, especially in Europe.

**Data security.** Computers can communicate with each other almost anywhere in the world. Data can be intercepted and copied or diverted to another computer. Computer enthusiasts called *hackers* use computers to gain illegal access to another computer's data and deliberately alter or destroy it. Most hackers do little harm, but some are engaged in financial fraud or espionage. Others tamper with important research.

Another threat to data comes from computer programs called *viruses*. These are designed to lurk hidden within other programs called *hosts*. When the host programs are run, the virus replicates itself, overwriting data already stored on the same disk and destroying other programs. Viruses may be imported on disks containing software or can be deliberately planted by hackers. Antivirus programs are continually being developed to combat viruses.

Data transmitted over a communication link can be protected by being coded. This process is called *encryption*. Special software carries out the encryption, and encrypted data can be decoded only by the receiving computer with the same software.

Data and programs on a computer or a network of linked computers can be protected by a procedure called *access control*. This process allows only authorized people to use the information held on the system. Various access control procedures exist, including the physical locking of the computer. *Password protection* requires a person to type in a secret arrangement of letters or digits before the computer may be used. Some networks have a piece of software called a *firewall*, which protects the network from outside interference.

See also **Database.**

**Database** is a body of information made up of individual items that are organized so that they can be reviewed in a variety of ways. Many databases are stored



**Microsoft Access - [The Categories Form]**

File Edit View Records Window Help

Filter/Sort: Field: Category Listing

## Grain & Cereal

**Description:** Breads, crackers, pasta, cereals, wafers, and related items

**Category:**

- DAIRY Dairy Products
- GRAN Grain & Cereal**
- MEAT Meat/Poultry

Product ID:	Product Name:	Unit Price:	Quantity Per Unit:
84	Wimmers gute Semmelknodel	\$33.25	20 bags x 4 pieces
42	Singaporean Hokkien Fried Mee	\$14.00	32 - 1 kg pkgs.
52	Fililo Mix.	\$7.00	16 - 2 kg boxes
56	Gnocchi di nonna Alice	\$38.00	24 - 250 g pkgs.
57	Ravioli Angelo	\$19.50	24 - 250 g pkgs.

**NORTHWIND TRADERS**

Record 15

The database display on the left can be used by a trader to review information about grains and cereals. Five product *records* (sets of data for individual items) run across the lower half of the screen. This information is organized into four *fields* (categories)—product *ID* (identification), product name, unit price, and quantity per unit.

on computers. Using a computerized database management system, a person enters information into the database according to various *fields* (categories). With a database program, the user can call up narrowly defined groups of data from storage. The computer displays the data on its screen. Some databases can perform mathematical and desktop publishing tasks (see Desktop publishing).

Major users of databases include libraries in which *on-line catalogues* (electronically stored lists consulted via a computer terminal) have replaced card catalogues. To determine whether a library has a certain book, an individual can select a field called *title*, then type all or part of the book's title. The person could also call up a list of all the library's books written by a certain author. The individual would select *author*, then type the author's name. Other fields in this program might be *subject*, *publisher*, *catalogue number*, and *publication date*.

Large stores use databases to keep track of customers' purchases and brand preferences. Many market research firms use databases to organize statistics on public opinion. Schools may use databases to maintain student records. Other bodies of information managed by database programs include mailing lists, certain medical records, recipe files, and tax records.

A computer user creates a database by entering information into one or more *files*. Each file consists of many *records*. Each record, in turn, contains pieces of information concerning one item. In a library's on-line catalogue, the items are the books. The individual pieces of information are organized into fields. In many database displays, a record runs horizontally across the screen, and fields appear as columns.

A *flat-file database*, such as an on-line catalogue, enables a user to call up data from only one file at a time. A *relational database* can draw data from more than one file. A librarian might use a relational database to search for information on a particular area of study. The database might list agencies doing research and periodicals that cover the subject area. Some relational databases

can also identify which of the periodicals cited are owned by the library. The database program might also produce information on people working in the particular field of study or information on books written about the subject.

See also Data protection.

**Date Line, International.** See International Date Line.

**Date palm** is the tree that produces dates. Date palms thrive in hot, dry climates. They grow throughout northern Africa and the Middle East, and they flourish in desert oases where few plants can grow. The date palm is one of the oldest crop plants. Early civilizations began to cultivate date palms at least 5,000 years ago. Today, dates still form an important part of the diet in many desert countries.

**Uses.** Date palms have many uses. They provide nourishment, shade, building materials, and fuel. They are especially important to Muslim peoples of the Middle East. According to Muslim legend, the date palm represents the tree of life.

Dates have a high sugar content, making them rich in carbohydrates. People eat dates fresh or dried. Dried dates can be used in cooking and can be easily stored and preserved. Sugar obtained from the sap of the tree and juice pressed from dates serve as sweeteners. Date mash ferments into an alcoholic drink called *arak*, also spelled *arrack*.

People use the trunk and leaves as building materials. They weave the leaves into baskets, mats, and other articles. Fibre from the bark makes strong rope. Even the fruit stones are burned as fuel or are used as animal feed when ground up.

**The tree.** Date palms grow as tall as 30 metres. They have a straight, rough trunk of about the same thickness from base to top. Featherlike leaves from 3 to 6 metres long fan out from the top of the trunk. Growths called *suckers* sprout near the base of the trunk and may develop into new plants. For this reason, date palms tend to grow in clumps.





**Clusters of dates** that may include as many as 1,700 dates each and weigh up to 11 kilograms grow on palm trees. The dates have a rich red or golden colour while on the tree.

Flowers bloom on the trees between February and June, and the fruit ripens from June to December. Male and female flowers grow on separate trees. Male flowers produce pollen, and female flowers develop into fruit.

**The date** is an oblong fruit that measures 2.5 to 5 centimetres in length. Thick, sweet flesh, covered by tough skin, surrounds a single large seed. Dates range in colour from yellow to orange, red, or green, depending on the variety.

Dates grow in clusters at the end of stalks. A single cluster on some mature varieties of date palm can hold between 600 and 1,700 dates at time of picking. Date palms bear a considerable amount of fruit. They commonly produce at least 45 kilograms of fruit annually for about 60 years.

**Cultivation and production.** Dates require warm temperatures and low humidity to ripen properly. The roots of the date palm need a regular supply of water, such as that provided by irrigation or an underground spring. Date palms may be raised from seeds. But growers more commonly raise them from suckers cut from a parent plant. They plant the suckers in rows about 9 metres apart. Trees begin to flower and bear fruit about four years after planting.

Pollen influences the size, shape, and ripening time of the fruit. Pollination can occur naturally by means of wind. But growers usually pollinate trees by tying a male flower cluster to a female cluster. Paper bags placed above the ripening fruit help prevent damage from rain. Netting or porous cloth placed over the clusters protects the fruit from insects and birds.

Workers harvest the clusters of dates by hand. They treat the dates with carbon bisulphide fumes to kill insects. They then put the dates in a warm place to ripen further and dry. This additional ripening increases the sugar content and reduces acidity.



**Date palms** thrive in hot, dry climates, such as the Middle East, northern Africa, and the deserts of California and Arizona, U.S.A. The date orchard shown above grows in Israel.

Growers produce nearly 2.7 million metric tons of fresh dates annually. Egypt and Saudi Arabia are the largest producers of dates. Other important producers include Algeria, Iran, Iraq, and Pakistan.

**Scientific classification.** The date palm belongs to the palm family, *Palmae*. It is *Phoenix dactylifera*.

See also **Palm**.

**Dating.** See **Sex** (Boy-girl relationships); **Adolescent; Marriage; Etiquette**.

**Datura** is a group of poisonous shrubs and trees, including jimson weed and angel's trumpet. These large bushy plants, also called *thorn apple*, have toothed, ill-smelling leaves, prickly fruit, and white to lavender trumpet-shaped flowers. *Daturas* are native to the tropics, but now grow on wasteland throughout temperate regions of the world.

**Scientific classification.** *Daturas* make up a genus in the nightshade family, *Solanaceae*. Jimson weed is *Datura stramonium*.

See also **Nightshade**.

**Daudet, Alphonse** (1840-1897), is sometimes called the French Dickens. Like the English author Charles Dickens, Daudet wrote about poor and suffering people and the outcasts of society. Both writers often softened their pictures of the cruelty of reality with a sympathy that occasionally became too sentimental. Daudet had a clear, graceful style. His simple observations of society and his humour and fantasy have made him a favourite with young readers.

Daudet is best known for his humorous short stories in *Letters from My Mill* (1866) and the patriotic stories in *Monday's Tales* (1873). The comic adventures of his boastful character Tartarin appear in two novels, *Tartarin of Tarascon* (1872) and *Tartarin over the Alps* (1895). Daudet also wrote serious realistic novels that contain excellent pictures of his time. These books include *The Nabob* (1877) and *Sapho* (1884).



Daudet was born in Nîmes. His parents were poor and he was bullied at school by his classmates and teachers. He described his unhappy youth in *Little What's Your Name* (1868), his first novel. He also wrote newspaper articles.

**Daugherty, James Henry** (1889-1974), was an American artist and author of children's books. He won the 1940 Newbery Medal for *Daniel Boone*, which he wrote and illustrated. Daugherty also wrote and illustrated *Andy and the Lion* (1938), *Poor Richard* (1941), *Abraham Lincoln* (1943), *Of Courage Undaunted* (1951), and *Magna Charta* (1956). Daugherty was born in Asheville, North Carolina.

**D'Aulaire** is the family name of a husband and wife who wrote and illustrated children's books.

Edgar Parin d'Aulaire (1898-1986) and his wife, **Ingri Mortenson d'Aulaire** (1904-1980), won the United States's Caldecott Medal in 1940 for their picture-book biography, *Abraham Lincoln*. They also won the Regina Medal in 1970. They drew directly on lithographic stone in making their illustrations. Their career as book collaborators began in 1931 with *The Magic Rug*.

Their books include *Ola, Ola and Blakken*, *Children of the North Lights*, *Conquest of the Atlantic*, *George Washington*, *Benjamin Franklin*, and *Pocahontas*. They also illustrated *The Lord's Prayer*, *East of the Sun and West of the Moon*, and *Johnny Blossom*.

Edgar was born in Campoblenio, Switzerland, and Ingri in Kongsberg, Norway. They met in Munich, Germany, and were married in 1925. They moved to the United States in 1929.

**Daumier, Honoré** (1808-1879), was a French artist and one of the most influential social critics of the 1800's. Daumier worked mainly in *lithography* (a type of printmaking), but he also gained recognition for his painting and sculpture. During his life, Daumier was best known for his satirical cartoons and *caricatures* (satirical portraits).

Daumier's works range from light satire to grim realism. Many of his caricatures ridicule middle-class tastes and values. He especially enjoyed attacking doctors and lawyers because he believed they used confusing language and special costumes to conceal their fraudulent practices.

Daumier often made small clay sculptures to use as models for his lithographs. One of the best examples of these sculptures is *Ratapoil*, a caricature of Emperor Napoleon III. This figure appears in several of Daumier's lithographs as a political troublemaker. Many of Daumier's paintings portray the working-class people of Paris. These works include *The Third Class Carriage* (about 1862) and *The Washerwoman* (1863).

Daumier was born in Marseille and grew up in Paris, where he worked as a lawyer's errand boy. His experiences in the courts and on the streets of Paris gave him insight into the social struggles of the period. While in his 20's, he studied drawing. He later worked as a cartoonist for French political magazines and newspapers. In 1832, he served six months in prison because of a caricature he drew of King Louis Philippe.

For other examples of Daumier's works, see **Painting** (What do painters paint?); **Realism**; **Bronze** (picture: Modern French sculpture).

**Dauphin** was the official title of the oldest son of the king of France from 1349 to 1830. The title was similar to that of "Prince of Wales" in England. The lords of Viennois and Auvergne, whose lands were known as Dauphiné, first used the title. The last lord of Viennois had no heir. He gave his lands to Philip VI, on condition that either the king or the heir to the throne should be lord of Dauphiné and have the title "Dauphin of France."

At first the dauphin had many privileges as ruler of his lands. But the title became merely honorary after Dauphiné was put under the same rule as the other provinces of France.

**Davao** (pop. 1,055,016) is a city in southern Mindanao in the Philippines. It is on the shores of Davao Gulf. For location, see **Philippines** (map).

Davao has an area of 2,440 square kilometres, and is the second largest urban area in the Philippines. It is the main commercial and trading centre of eastern and southeastern Mindanao. Important products of the region include maize, *abaca* (a plant used to make Manila hemp), pineapples, and timber. The fishing industry is also important.

Davao is a leading recreation centre in the southern Philippines. Good beaches line the gulf, providing tourists with bathing and water sport facilities.

Davao is heavily populated and immigrants from Luzon and the Visayas Islands continue to increase the population. The Pan-Philippine Highway connects Davao with Aparri in northern Luzon. Domestic airlines also serve the city, linking it with Manila and Cebu.

A major tourist attraction is Aguinaldo Pearl Farm, which has two hotels—one land-based, the other floating. Religious relics in Davao include the Shrine of the Holy Infant of Jesus of Prague. It is located at Matina Heights, about 6 kilometres from the city. There is also an open-air chapel containing replicas of the Holy Infant and of our Lady of Fatima.

Before World War II (1939-1945), Davao developed as a port for the export of Manila hemp. The city was destroyed during the war. It was rebuilt afterward and was capital of Davao province until the province was split into three.

See also **Mindanao**.

**Davenant, Sir William** (1606-1668), was an English playwright. His romantic plays and elaborate spectacles



A Daumier painting shows characters in a comedy by French playwright Molière. The theatre inspired many Daumier works.



called *masques* gained him an appointment as poet laureate in 1638. But his reputation now rests on his techniques in staging plays.

Davenant trained the first actresses to replace the boy actors who had played all female roles in plays in England. In place of the bare open-air Elizabethan stages, he introduced to the English theatre the painted scenery and artificial lighting used in continental Europe. Davenant wrote the words for what is generally considered the first English opera, *The Siege of Rhodes* (1656). He is generally blamed for cutting and rewriting some of Shakespeare's plays to fit new theatrical conditions and the changing taste of the audience. Davenant was born in Oxford. He founded the Duke of York's Playhouse in London in 1660.

**Daventry** (pop. 61,600) is a local government district in Northamptonshire, England. It consists of a pleasant rural area surrounding the historic town of Daventry. There were settlements in the Daventry area in Stone Age and Roman times. Cluniac monks founded a priory there in 1265. Daventry was a staging post for coaches from London, but the town declined with the coming of the railways. Agriculture is the main activity. New industries include engineering and the production of plastics, machine tools, and motorcar spares. The British Broadcasting Corporation has a transmitter at Daventry. See also **Northamptonshire**.

**Davey, Thomas** (1760?-1823), was lieutenant governor of Van Diemen's Land (now Tasmania) from 1813 to 1817. He was a controversial administrator, and was recalled after settlers complained about him. But he did much to develop the colony by encouraging farming, improving the port of Hobart, and stimulating public works and buildings. In 1815, he angered Governor Lachlan Macquarie by illegally declaring martial law in the colony to end bushranging. Macquarie gave him a large grant of land as compensation for his recall. Davey was born in Devon, England.

**David** (1030?-965? B.C.) was the second king of Israel and one of the greatest figures in the history of the Jews. He succeeded Saul as king about 1000 B.C. and ruled for about 40 years, longer than any other king of ancient Israel.

More chapters of the Bible are devoted to David's reign than to that of any other monarch. The Old Testament also tells more about David as a person than about any other king. The prophets declared that a descendant of David would become the *Messiah*, an ideal king. This king would bring a golden age of peace, justice, and prosperity to Israel. The New Testament traces the ancestry of Jesus Christ back to David.



Marble statue (1504) by Michelangelo: Galleria dell'Accademia, Florence, Italy

**David**



**David and Goliath** is one of many Biblical scenes painted by Michelangelo on the ceiling of the Sistine Chapel in the Vatican.

The Old Testament portrays David as a great warrior and as a strong, popular leader. It also tells of his talents as a musician and poet. When David was a youth, his lyre playing endeared him to King Saul. Later, David composed one of his most beautiful and sensitive poems as a tribute to Saul and his son Jonathan after they died in battle. According to tradition, David also wrote many of the Psalms in the Old Testament (see **Psalms**, Book of).

**Early life.** David was born in Bethlehem. His father was a shepherd named Jesse. David was the youngest of eight brothers and spent his early years tending his father's sheep. He later became a member of King Saul's court, where he formed a close friendship with Saul's son Jonathan. At that time, the Philistines were Israel's main enemy. The most famous story of David's youth tells of his battle with a Philistine warrior named Goliath. Armed only with a sling and five stones, David killed the giant Goliath.

David's courage and skill in battle quickly made him a hero among the people of Israel. As his popularity grew, however, Saul became extremely jealous of David and tried to kill him. David fled to the area of Israel where the tribe of Judah lived. There he gathered an army of followers. After Saul was killed in battle against the Philistines, David became king of Judah. David ruled Judah for 7½ years and then was named king of all Israel.

**King of Israel.** During his reign, David established Israel as a major power in western Asia. His troops defeated the Philistines, ending their threat to Israel's security. David also greatly expanded Israel's territory through a series of wars against the Ammonites, Moabites, and other neighbouring peoples. He formed an alliance with the Phoenicians, who sent badly needed craftworkers and supplies to Israel.

David was an able ruler and administrator. He united his people and overcame the disunity that had interfered with Saul's reign. He established his capital in Jerusalem, which was centrally located and acceptable to all Israel's tribes. He also made Jerusalem the spiritual centre of Israel by having the Ark of the Covenant moved to the city. The Ark was the sacred chest that contained the



tablets inscribed with the Ten Commandments.

During the last years of David's reign, his sons plotted and struggled among themselves to determine who would succeed him. His son Absalom rebelled against him and forced him to flee Jerusalem. David's troops eventually killed Absalom and regained control of the kingdom, but David mourned bitterly for his son. According to the Bible, these troubles were punishment for a sin that David committed. Years earlier, David had committed adultery with a beautiful woman named Bathsheba and had her husband killed in battle so he could marry her. David died about 965 B.C. His son Solomon then became king.

**Related articles in *World Book* include:**

Goliath	Sculpture (picture: <i>David</i> by
Hittites	Donatello)
Philistines	Solomon
Saul	

**David** was the name of two kings of Scotland.

**David I** (1084-1153), the youngest son of Malcolm III Canmore, became king of Scotland in 1124. He invaded England twice, once to support his niece Matilda's claim to the English throne, and again to gain the earldom of Northumbria for his son, Henry. During his reign, David won the support of the many Anglo-Norman barons in Scotland.

**David II** (1324-1371), the son of Robert Bruce, was married to Joanna, daughter of King Edward II of England, at the age of 4. He became king in 1329. David fled to France when England invaded Scotland. He later fought with France against England in 1346. The English captured him. They released him 11 years later, and he returned to Scotland.

**David, Jacques Louis** (1748-1825), was the leading French painter during the French Revolution and the Napoleonic era. He painted primarily in the neoclassical style, which emphasizes solidly modelled forms, realistic details, and balanced composition. Neoclassicists often used subjects from ancient history to make observations about contemporary events. David's famous painting *The Oath of the Horatii* (1784) reflects neoclassical style and subject matter. This painting appears in *Painting* (The 1800's).



Unfinished oil painting on canvas (1800);  
The Louvre, Paris

**Jacques Louis David's *Portrait of Madame Récamier*** emphasizes solidly modelled forms, realistic details, and balanced composition. These qualities are typical of his neoclassical style.

David was an active participant in the French Revolution and voted for the death of King Louis XVI. He started to depict the events of the revolution in the unfinished *The Oath of the Tennis Court*, which he began in 1791. In 1793, he painted *The Death of Marat*, a moving portrait of the assassinated revolutionary leader. David was an ardent supporter of Napoleon, and he glorified some of the main events of the emperor's life in his paintings.

David was born in Paris. His work influenced many of the major artists of the 1800's, including many members of the impressionist movement.

See also **Clothing** (picture: Women's clothing); **French Revolution** (picture: *The Death of Marat*); **Napoleon I** (pictures: Napoleon I; *The Coronation of Napoleon*); **Socrates** (picture).

**David, Saint** (520?-589?), is the patron saint of Wales. Almost no authentic information exists on David's life. He is said to have founded a number of Welsh monasteries, including St. David's at Mynyw (Menevia) in southwestern Wales. Mynyw is now called St. David's. After David's death, a widespread belief grew that he had served as the leader of the Welsh church. Perhaps as a result, Mynyw became a centre of religious authority for much of Wales.

According to legend, David was born into a prominent Welsh family and studied under the monk Saint Paulinus. In works of art, David is shown standing on a mound with a dove perched on one shoulder. His feast day is celebrated on March 1. In Welsh, Saint David is known as Dewi Sant.

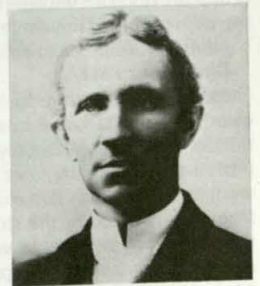
**David, Sir T. W. E.** (1858-1934), an author, explorer, and geologist, became famous for his scientific expeditions in Australasia. In

1897, he led a scientific expedition to the Ellice Islands to test a theory about the formation of coral atolls. From 1907 to 1909, he was scientific officer in Sir Ernest Shackleton's expedition and led a party that came within 156 kilometres of the South Magnetic Pole (see **Shackleton, Sir Ernest**). Tannant William Edgeworth David was born near Cardiff in Wales. From 1891 to 1924, David was professor of geology at Sydney University. He was knighted in 1920.

**David Copperfield.** See **Dickens, Charles** (The second phase).

**Davidson, Jo** (1883-1952), an American portrait sculptor, created heads of many famous people. His work is direct and lifelike. His goal was to record the famous men and women of his day. Davidson worked chiefly in terracotta and bronze. His best-known works include portraits of Mohandas Gandhi, D. H. Lawrence, and Franklin D. Roosevelt.

Davidson was born in New York City. He studied for three years at the Art Students' League there, but then decided on a medical career. While at Yale Medical School, he saw work done by art students in a model-



Sir T. W. E. David



ling class and chose to become a sculptor. He went to Paris in 1907 to work and study there.

**Davidson, Philmore "Boots"** (1927-1993), was a musician who introduced steel drums to the United Kingdom (UK). He founded the steel band Casablanca, which became famous for its calypso-style rhythms. Davidson visited the UK in 1951 with the Trinidad All-Steel Percussion Orchestra. In 1956, he emigrated to the UK and eventually became a full-time musician and teacher. After his early experiments with oil drum bands in Trinidad, Davidson invented the "guitar drum," a cross between the rhythm drum and the tenor drum. Philmore Gordon "Boots" Davidson was born in Trinidad. See also *Steel band*.

**Davies, Sir Henry Walford** (1869-1941), a British composer, is best remembered for his church music. He was also a distinguished organist, and became famous with his broadcast talks on music. Among his most successful works were the oratorio *Everyman* and the organ piece "Solemn Melody." Davies's finest music is probably to be found in his choral and organ works, which reveal his spiritual qualities, skill, and wit. Davies was born at Oswestry, in Shropshire, England. He was organist at several London churches. He was made Master of the King's Music in 1934.

**Davies, Sir Peter Maxwell** (1934- ), is a British composer and conductor. His compositions, known for their progressive quality, are written in a distinctive modern idiom. He mainly uses techniques adapted from early music. Davies wrote many works for the Fires of London, a musical group of which he became the director in 1971. It disbanded in 1987.

Davies, born in Manchester, England, was educated there, in Italy, and in the United States. After a period of teaching, he went to live in Orkney.

Deeply influenced by the story of St. Magnus, a ruler of the Orkneys, Davies set to music the *Hymn to St. Magnus* in 1972 and wrote an opera, *The Martyrdom of St. Magnus* in 1977. He directed the St. Magnus Festival in Orkney from 1977 to 1986. His other works include *Eight Songs for a Mad King* (1969), a theatre piece depicting the insanity of George III, and *Taverner* (1970), an opera about the Tudor composer, John Taverner. His instrumental works include *St. Thomas' Wake; Foxtrot for Orchestra* (1969). He also wrote the film music for *The Devils* and *The Boyfriend* (both 1971), symphonies, concertos for various instruments, and some choral pieces. Davies became associate conductor and composer of the Scottish Chamber Orchestra in 1985. He was knighted in 1987.

**Davies, Robertson** (1913- ), is a Canadian novelist, playwright, and journalist. His first three novels are social comedies examining the eccentricities of a small Ontario university town. They are *Tempest-Tost* (1951), *Leaven of Malice* (1954), and *A Mixture of Frailties* (1958). In *A Mixture of Frailties*, Davies described the artistic

development of a gifted young Canadian singer. In the three novels known as the Deptford trilogy, he explored the relationship between magic, religion, and psychology. These novels are *Fifth Business* (1970), *The Manticore* (1972), and *World of Wonders* (1975). *The Rebel Angels* (1982), *What's Bred in the Bone* (1985), and *The Lyre of Orpheus* (1988) make up a third trilogy steeped in Canadian history and exotic lore.

William Robertson Davies was born in Thamesville, Ontario, and was educated in Canada and England. He worked in England as an actor, stage manager, director, and drama teacher. He later wrote critical studies in drama history and several plays. His best known plays include *Eros at Breakfast* (1949), *Fortune, My Foe* (1949), and *At My Heart's Core* (1950).

In 1942, Davies became editor of the *Peterborough* (Ontario) *Examiner*. He wrote a syndicated column of witty observations on small-town American and Canadian life. Selections from this column were collected in *The Papers of Samuel Marchbanks* (1985). A collection of Davies's speeches and lectures was published as *One Half of Robertson Davies* (1978). From 1963 to 1981, Davies served as master of Massey College for graduate students at the University of Toronto.

**Davies, William Henry** (1871-1940), a British poet and author, led a roving life as a tramp, pedlar, and street singer. He told the story of some of his wanderings in his *Autobiography of a Super Tramp* (1908). His other works include *A Soul's Destroyer* (1905), and *Nature Poems and Others* (1908). Davies was born at Newport, in Gwent, South Wales. At 22, he emigrated to the United States. He returned to Britain after losing a leg while attempting to board a moving train bound for the Klondike River Valley, Canada. Although his works were widely acclaimed, Davies shunned publicity.

**Da Vinci, Leonardo.** See *Leonardo Da Vinci*.

**Davis** is the family name of two English brothers who became famous snooker and billiards players.

**Joe Davis** (1901-1978) won the world snooker championship in 1927, and held the title until he retired undefeated in 1946. He also held the United Kingdom Billiards Championship from 1928 to 1946. Joe Davis was the first man to achieve the maximum possible break of 147. His highest billiards break was 2,501. He was born at Whitwell, in Derbyshire.

**Fred Davis** (1913- ), Joe's younger brother, won many championships, but never achieved the same degree of perfection as his brother. He was born at Chesterfield, in Derbyshire.

**Davis, Bette** (1908-1989), was an American film actress known for her portrayals of strong-willed women. Davis won Academy Awards as best actress for her performances in *Dangerous* (1935) and *Jezebel* (1938). She received eight other Academy Award nominations.

Ruth Elizabeth Davis was born in Lowell, Massachusetts. She studied acting in New York City and ap-



Sir Peter Maxwell Davies



Bette Davis



peared in several plays before beginning her film career. Davis made her first film, *Bad Sister*, in 1931. She made 85 films, including *Of Human Bondage* (1934), *Dark Victory* (1939), *The Letter* (1940), *Now, Voyager* (1942), *The Corn Is Green* (1945), *All About Eve* (1950), and *Whatever Happened to Baby Jane?* (1962). Davis also wrote two autobiographies, *The Lonely Life* (1962) and *This 'n That* (1987).

**Davis, Sir Colin** (1927- ), a British conductor, is remarkable for the originality and freshness of his interpretations. He made his debut as a conductor with the Mozart Opera Company in 1952. From 1959 to 1961 he was conductor of the Sadler's Wells Opera Company, and from 1961 to 1965 was its musical director. He became chief conductor for the BBC Symphony Orchestra in 1967. Davis served as Musical Director of the Royal Opera House, Covent Garden, from 1971 until he retired from this post in 1986. During the same period he also served as principal guest conductor with the Boston Symphony Orchestra and appeared with other internationally famous orchestras. From 1983 to 1992, he conducted the Bavarian Radio Symphony Orchestra in Germany. In 1974, he began a long association with the London Symphony Orchestra, becoming its principal conductor in 1995.



Sipa-Rex

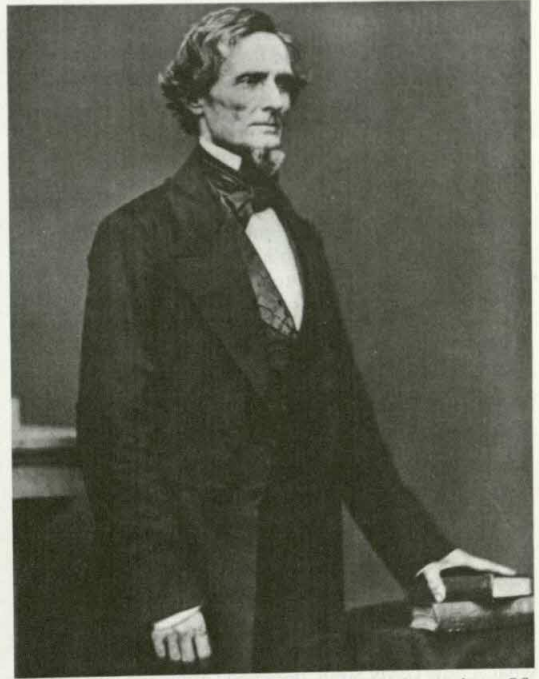
**Sir Colin Davis.** In 1975, he became the first British conductor to perform at the Bayreuth festival in Germany.

Davis was born at Weybridge, in Surrey. He studied at the Royal College of Music and became an accomplished clarinetist. He was knighted in 1980.

**Davis, Jefferson** (1808-1889), served as president of the Confederate States of America during the American Civil War. He was born on June 3, 1808, in Christian (later Todd) County, Kentucky, but grew up in Mississippi. At the age of 16, he entered the U.S. Military Academy, and graduated in 1828.

Davis's army career took him to the Wisconsin frontier where he fought in campaigns against the Indians. Davis resigned from the army in 1835. He married in that year, but his wife soon died of fever. He became a wealthy cotton planter, and remarried in 1845.

**His political career.** Davis became interested in politics in 1843, and won a seat as a Democrat in the U.S. House of Representatives in 1845. He resigned from



Photograph by Matthew Brady. National Archives, Washington, D.C.

**Jefferson Davis** became the provisional president of the Confederate States of America on Feb. 18, 1861.

Congress in June 1846 to become a colonel in a regiment of Mississippi volunteers in the Mexican War. He served under General Zachary Taylor (father of his first wife) in northern Mexico, and distinguished himself for outstanding bravery in the battles of Monterrey and Buena Vista.

The governor of Mississippi appointed Davis in 1847 to replace a United States senator who had died. The next year the state legislature elected him for the rest of the term, and in 1850 for a full term. A strong believer in states' rights, Davis ran unsuccessfully for governor of Mississippi.

**Secretary of war.** President Franklin Pierce appointed Davis secretary of war in 1853. Davis improved and enlarged the U.S. Army. He introduced infantry tactics, and new and better weapons. He organized engineer companies to explore routes for railways from the Mississippi River to the Pacific Coast. At the close of the Pierce administration in 1857, Davis was reelected to the Senate from Mississippi. In the Senate, Davis no longer advocated secession, but he defended the rights of the South and slavery. He opposed Stephen A. Douglas's "Freeport Doctrine," which held that the people of a territory could exclude slavery by refusing to protect it. Davis also opposed Douglas's ambition to be the Democratic presidential candidate in 1860.

**Spokesman for the South.** Davis became the champion of the constitutional right of a state to choose and maintain its own institutions. He demanded that Congress protect slavery in the territories. In the positions he took, Davis considered himself the heir of Southern leader John C. Calhoun.



After Abraham Lincoln was elected president of the United States, Mississippi passed an Ordinance of Secession, and Davis resigned from the Senate. Davis hoped to become head of the Army of the Confederate States. But instead he was named provisional president of the Confederacy. He took the oath of office on Feb. 18, 1861. He was inaugurated as president of the Confederacy on Feb. 22, 1862.

**Leader of the Confederacy.** Davis was probably not the wisest choice for president. His health was poor. Although he was a good administrator, he proved to be a poor planner. He had difficulties with his Congress, and bitter critics condemned his management of the war. Some modern historians view Davis as a rigid constitutionalist who was too inflexible in his ideas.

Soon after General Robert E. Lee surrendered, Davis was taken prisoner, and imprisoned. Indicted for treason, he was held in prison for two years awaiting trial. In 1867, he was released on bail. He was never tried.

Davis spent his last years writing and studying at home in Mississippi. He died on Dec. 6, 1889, and was buried in New Orleans. His body was moved to Richmond, Virginia, in 1893.

See also **American Civil War; Confederate States of America; Richmond; Alabama.**

**Davis, John** (1543-1605), also spelled *Davys*, an English mariner and explorer, was the first European to discover what is now Davis Strait, between Greenland and Canada. He led the way for such explorers of northeast Canada as Henry Hudson and William Baffin. Davis was one of the most skilled navigators of the late 1500's. He invented a type of *quadrant*, a device used in navigation, and developed the recording technique that became the standard ship's log.

From 1585 to 1587, Davis headed three expeditions in search of the Northwest Passage, a route through Canada between Europe and Asia (see **Northwest Passage**). He discovered Davis Strait on his first trip. During his voyages, Davis explored the east coast of Baffin Island and the west coast of Greenland but did not find a route west. From 1591 to 1593, he tried to find a passage to Asia via the Strait of Magellan in South America. He failed to do so but sighted the Falkland Islands, off the southeast coast of South America. Davis became a pilot for the East India Company's first fleet to East Asia. He was killed by Japanese pirates. Davis was born at Sandridge, in Devon, England.

**Davis, Miles** (1926-1991), was one of the most influential American jazz trumpeters and bandleaders in jazz history. He became famous for a forceful but lyrical trumpet style. His moody tone and original ideas made him one of the most imitated musicians of his day.

Miles Dewey Davis, III, was born in Alton, Illinois. In 1945, he went to New York City to study music at the Juilliard School. However, he spent most of his time performing with jazz bands, including a quintet led by alto saxophonist Charlie Parker. That group helped create the complex, modern form of jazz known as *bebop* or *bop*. In 1948, Davis formed a nine-piece recording unit that helped develop *cool jazz*, a style that emphasized rich ensemble colours and emotional restraint.

During the 1950's, Davis's bands performed in a more energetic style, though his playing continued to emphasize melody. His major recordings include *Miles Ahead*



Duncan Schiedt

**Miles Davis, right**, was an influential jazz trumpet player from the late 1940's until his death in 1991. During the 1950's, he led an important combo that included alto saxophonist Julian "Cannonball" Adderly, left, and bassist Paul Chambers, centre.

and *Porgy and Bess*, both arranged for trumpet and orchestra by Gil Evans, and the sextet session *Kind of Blue*. Many musicians gained their first recognition in Davis's bands, including saxophonists John Coltrane and Wayne Shorter; pianists Red Garland, Bill Evans, and Herbie Hancock; bassists Paul Chambers and Ron Carter; and drummers Philly Joe Jones and Tony Williams. From the late 1960's, until his death Davis pioneered in *fusion*, which combined elements of rock music with jazz.

See also **Jazz** (Cool jazz; New directions).

**Davis, Stuart** (1894-1964), was an American painter and illustrator. His bright, lively paintings deal with everyday life. Davis tried to combine a modern abstract style with distinctly American scenes and objects. Bold areas of intense, pure colour and rugged written lines characterize his work. He often included words from street signs and billboards. Davis was inspired by such things as jazz, films, petrol stations, shop fronts, and mass-produced objects.

Davis was born in Philadelphia. At 19, he exhibited in the Armory Show of 1913. The works of Vincent van Gogh, Paul Gauguin, and Henri Matisse impressed him at this exhibition. His mature style also shows the influence of such cubist painters as Fernand Léger and Pablo Picasso. He did murals for Radio City Music Hall and Rockefeller Center in New York City.

See also **Painting** (picture: *The Barber Shop*).

**Davis, Thomas** (1814-1845), was an Irish essayist, poet, and patriot. He was one of the leaders of the Young Ireland movement, and one of its founders with John Blake Dillon and Charles Gavan Duffy. To further the aims of Young Ireland, Davis and his friends founded the newspaper *The Nation*. Davis was the chief writer on the paper, and for the three years before his death contributed hundreds of poems and essays. Davis



## Davis Cup tournament

Year	Winner	Runner-up	Score	Year	Winner	Runner-up	Score
1900	United States	Great Britain	3-0	1947	United States	Australia	4-1
1901	No competition			1948	United States	Australia	5-0
1902	United States	Great Britain	3-2	1949	United States	Australia	4-1
1903	Great Britain	United States	4-1	1950	Australia	United States	4-1
1904	Great Britain	Belgium	5-0	1951	Australia	United States	3-2
1905	Great Britain	United States	5-0	1952	Australia	United States	4-1
1906	Great Britain	United States	5-0	1953	Australia	United States	3-2
1907	Australia and New Zealand	Great Britain	3-2	1954	United States	Australia	3-2
1908	Australia and New Zealand	United States	3-2	1955	Australia	United States	5-0
1909	Australia and New Zealand	United States	5-0	1956	Australia	United States	5-0
1910	No competition			1957	Australia	United States	3-2
1911	Australia and New Zealand	United States	5-0	1958	United States	Australia	3-2
1912	Great Britain	United States	5-0	1959	Australia	United States	3-2
1913	United States	Australia and New Zealand	3-2	1960	Australia	Italy	4-1
1914	Australia and New Zealand	Great Britain	3-2	1961	Australia	Italy	5-0
1915-1918	No competition			1962	Australia	Mexico	5-0
1919	Australia and New Zealand	United States	5-0	1963	United States	Australia	3-2
1920	United States	Australia and New Zealand	5-0	1964	Australia	United States	3-2
1921	United States	Japan	5-0	1965	Australia	Spain	4-1
1922	United States	Australia and New Zealand	4-1	1966	Australia	India	4-1
1923	United States	Australia and New Zealand	4-1	1967	Australia	Spain	4-1
1924	United States	Australia and New Zealand	5-0	1968	United States	Australia	4-1
1925	United States	France	4-1	1969	United States	Romania	5-0
1926	United States	France	4-1	1970	United States	West Germany	5-0
1927	France	United States	3-2	1971	United States	Romania	3-2
1928	France	United States	4-1	1972	United States	Romania	3-2
1929	France	United States	3-2	1973	Australia	United States	5-0
1930	France	United States	4-1	1974	South Africa	India	*
1931	France	Great Britain	3-2	1975	Sweden	Czechoslovakia	3-2
1932	France	United States	3-2	1976	Italy	Chile	4-1
1933	Great Britain	France	4-1	1977	Australia	Italy	3-1†
1934	Great Britain	United States	4-1	1978	United States	Great Britain	4-1
1935	Great Britain	United States	5-0	1979	United States	Italy	5-0
1936	Great Britain	Australia	3-2	1980	Czechoslovakia	Italy	4-1
1937	United States	Great Britain	4-1	1981	United States	Argentina	3-1†
1938	United States	Australia	3-2	1982	United States	France	4-1
1939	Australia	United States	3-2	1983	Australia	Sweden	3-2
1946	United States	Australia	5-0	1984	Sweden	United States	4-1
				1985	Sweden	West Germany	3-2
				1986	Australia	Sweden	3-2
				1987	Sweden	India	5-0
				1988	West Germany	Sweden	4-1
				1989	West Germany	Sweden	3-2
				1990	United States	Australia	3-2
				1991	France	United States	3-1†
				1992	United States	Switzerland	3-1†
				1993	Germany	Australia	4-1
				1994	Sweden	Russia	4-1

\*Won by default.

†Fifth match suspended by mutual consent.

There was no competition from 1940 to 1945.

addressed his essays to the depressed and dispossessed common people of Ireland. He was deeply concerned to inspire in them pride in their history, music, art, and cultural traditions. The policy advocated by Davis can be summed up in his own words: "From whatever stock they spring, Celtic, Norman or Saxon, if men love and serve the country, they are Irish."

Davis was born at Mal-low, in Cork. He studied law at Trinity College, Dublin. In 1838, he was called to the Bar. He died of scar-let fever.

**Davis Cup** is a silver bowl trophy awarded each year to the nation that wins the world's men's tennis championship. Dwight F. Davis, a leading American tennis player, donated the cup in



Thomas Davis

1900, and competition began that year. Competition for the Davis Cup consists of an elimination tournament among 16 qualifying nations. A separate tournament is held for nations that have not qualified. These nations are divided into four zones. The winner of each zone advances to the cup competition for the next year, replacing the nations with the poorest record. See also **Tennis** (Tennis today).

**Davis Strait.** See Davis, John; Northwest Passage. **Davison, Frank Dalby** (1893-1970), an Australian writer, became known for novels and short stories that reflect his affection for country life and especially for animals. He was born at Glenferrie, in Victoria, and spent many years on country properties in various Australian states.

Davison is best known for his second novel, *Man-Shy* (1931), which won the Australian Literature Society Medal. *Man-Shy* is a short novel about a red heifer and its encounters with wild scrub cattle. Critics consider it a classic of its kind. Davison was the first Australian writer to attempt this treatment of an animal subject. He presented the animal as a character in its own right, and al-



lowed each event of the plot to be seen through the mind of the animal. There is a clear, detailed account of all incidents, obviously gained from keen observation of the countryside and animal behaviour.

*Dusty* (1946) tells the story of a half-dingo sheepdog that changes from an ordinary working dog to killer, causing its owner's death. It is an understanding portrayal of the animal's reaction to the conflicts arising from its mixed ancestry.

Other works by Davitt include *The Wells of Beersheba* (1933), a story of World War I, and *Children of the Dark People* (1936), an imaginative tale of Aboriginal children.

**Davitt, Michael** (1846-1906), was one of the chief leaders in the movement to reform the land system in Ireland. In order to achieve this aim, he founded the *Land League* in 1879. The league's aim was to make every tenant farmer owner of his land. Davitt also cooperated with Charles Stewart Parnell to gain Home Rule for Ireland.

Davitt was born at Straide, in Mayo, the son of a tenant farmer. In 1852, the family was evicted by its landlord and emigrated to Lancashire, England. Davitt began work in a cotton mill at the age of 10. Soon afterward, Davitt lost an arm in an accident. In 1865, he joined the *Fenian Brotherhood*, an organization that aimed to make Ireland a republic. Davitt was jailed in 1870 on a charge of treason.

See also *Ireland, History of* (Home Rule and the Land League); Parnell, Charles Stewart.

**Davy, Sir Humphry** (1778-1829), an English chemist, rose to fame as inventor of the miner's safety lamp. The Davy lamp, perfected in 1815, greatly reduced the risks of coal mine explosions. At the age of 20, Davy experimented with the use of nitrous oxide, or laughing gas, as an anaesthetic. When he was 29, he became the first person to isolate the elements sodium and potassium. He did this by passing an electric current through the fused hydroxides of these elements. He was also first to isolate barium, calcium, magnesium, and strontium.

Davy was born in Penzance, England. In 1802, he became professor of chemistry at the Royal Institution in London. The English chemist and physicist Michael Faraday was his assistant. Davy was knighted in 1812, and elected president of the Royal Society in 1820.

See also *Aluminium* (History); *Electric arc*; *Safety lamp*; Faraday, Michael; Chlorine.

**Davy Jones**, in sailors' folklore, is the wicked spirit who rules over the souls in the ocean deep. He is known chiefly through the proverbial term for the bottom of the sea, *Davy Jones's locker*. This is the final resting place of lost articles, sunken ships, and sailors who have drowned or been buried at sea. Thus, Davy Jones's locker has come to mean death. Some people have tried to trace Jones to Jonah, the Hebrew prophet who lived three days in the belly of a fish.

**Davys, John**. See Davis, John.

**Dawe, Bruce** (1930- ), an Australian poet, wrote a number of books of poetry from *No Fixed Address* (1962) to *Towards Sunrise: Poems 1979-1986* (1986). His other works include *A Need of Similar Name* (1965), *An Eye for a Tooth* (1968), *Beyond the Subdivisions* (1969), *Heat-Wave* (1970), *Condolences of the Season* (1971), and *Over Here, Harv! and Other Stories* (1983).

Dawe was converted to Roman Catholicism and some of his early verse reflects his religious attitudes. His poetry explores a variety of social issues and their impact on the individual. His unique and original use of the cadences of Australian speech give his work a definite Australian flavour. Bruce Dawe was born at Geelong in Victoria. He left school at 16 and worked at manual jobs. He later became a senior lecturer in literature at the Darling Downs Institute of Advanced Education, Queensland.

**Dawes Act**. See *Indian Territory*; *Indian, American* (The fall of Indian America).

**Daws, Lawrence** (1927- ), an Australian painter, studied at the National Gallery of Victoria Art School from 1949 to 1953. But the precise and geometrically ordered nature of his early paintings originated in his studies of engineering and architecture at the University of Adelaide and two years of survey work in New Guinea. Daws developed a respect for craftsmanship that remains an important characteristic of his work.

Lawrence Daws was born in Adelaide. Success in the Dunlop competitions in Melbourne in 1953 and 1954 brought him into prominence. He won an international prize at the *Biennale des Jeunes* in Paris in 1962.

**Dawson, George Mercer** (1849-1901), was a Canadian geologist and the son of the geologist Sir John William Dawson. George Dawson joined the Geological Survey of Canada in 1875 and became its director in 1895. The Survey published much of his work, including the first detailed investigations of the geology and natural resources of British Columbia and the Yukon. Dawson also published geographical descriptions of Canada and was coauthor of a study of Indian languages. During the 1870's, he called attention to the rich beds of dinosaur fossils located in Alberta.

Dawson was born in Pictou, Nova Scotia. He attended McGill University in Montreal and the Royal School of Mines in London. Dawson, the capital of the Yukon Territory from 1898 to 1953, is named after him.

**Dawson, Sir John William** (1820-1899), was a Canadian geologist and educator. His major work was *Acadian Geology* (first published in 1855), a study of rock formations in Nova Scotia. The book vigorously opposed the theory of naturalist Louis Agassiz that a huge sheet of ice once covered large regions of the Northern Hemisphere. Dawson incorrectly believed that glaciers had covered only small areas of the earth.

Dawson also wrote about coal deposits and the fossils they contain. He discovered important early amphibians and reptiles. In addition, Dawson published on natural history, agriculture, evolution, fossils, and the relationship between science and religion.

Dawson was born in Pictou, Nova Scotia. He served as principal of McGill University in Montreal from 1855 to 1893. In 1882, Dawson became the first president of the Royal Society of Canada.

**Dawson, Peter** (1882-1961), an Australian baritone, featured on some of the earliest gramophone recordings. In 1902 he went to live in the United Kingdom. He made his first recordings for Edison-Bell Phonograph Company in 1904. His first appearance in grand opera was at Covent Garden, London, in 1909. Dawson eventually retired to Australia, and in 1951 published his autobiography, *Fifty Years of Song*.



**Day.** While the earth travels through space around the sun, it also spins on its own axis. A *solar* day is the length of time that it takes the earth to turn around once with respect to the sun. We usually say *day* for the time when the sun is shining on our part of the earth, and *night* for the time when our part of the earth is dark, or turned away from the sun. But the night is really a part of the whole day. We also say *business day* sometimes to mean the hours of business in any one day.

Each day begins at midnight. In most countries, the day is divided into two parts of 12 hours each. The hours from midnight to noon are the a.m. (*ante meridiem* or before noon) hours. The hours from noon to midnight are the p.m. (*post meridiem* or after noon) hours. The military services often designate the time of day on a 24-hour basis, such as 0000 for midnight, 0100 for one o'clock in the morning, 1200 for noon, and 1800 for six o'clock in the evening.

Among ancient societies, the Babylonians began their day at sunrise. The ancient Jews began the day at sunset. The Egyptians and the Romans were the first to begin the day at midnight.

The length of daylight changes during the year in all parts of the world. It does so because the tilt of the earth's axis causes first one pole to slant toward the sun and then the other as the planet orbits the sun. The longest day in the Northern Hemisphere usually is June 21 and that in the Southern Hemisphere is December 21. Each of these days has 13 hours and 13 minutes of daylight at 20° latitude. The same days have 14 hours and 30 minutes of daylight at 40° latitude, and 18 hours 30 minutes at 60°. The shortest day in the Northern Hemisphere usually is December 21 and that in the Southern Hemisphere is June 21. Each has only 10 hours and 47 minutes of daylight at 20° latitude, 9 hours 9 minutes at 40°, and 5 hours and 30 minutes at 60°. The length of daylight changes very little during the year at the equator.

When the tilt of the earth's axis causes the North Pole to face the sun, the South Pole is continuously dark and the North Pole is always in daylight. As the North Pole is tilted away from the sun, it becomes dark there while the South Pole has constant daylight. These periods of darkness and daylight last about six months.

Astronomers use a day called a *sidereal day*. It is based on the period of the earth's rotation as measured

by fixed stars. This day equals 23 hours 56 minutes 4.091 seconds of mean solar time.

See also articles on the days of the week; **Daylight saving**; **Sidereal time**; **Time**; **Twilight**.

**Day, Clarence** (1874-1935), was an American writer. He became known chiefly for two books of humorous sketches about his family, *Life with Father* (1935) and *Life with Mother* (published in 1937, after his death). These books were made into the play *Life with Father* (1939), which became one of the most popular plays in American theatre history.

Day also wrote essays, stories, and reviews. Many were published in such collections as *The Crow's Nest* (1921), *Thoughts Without Words* (1928), and *Scenes from the Mesozoic* (1935). Day's cartoonlike drawings added humour to his books.

Clarence Shepard Day was born in New York City.

**Day care** is a service in which children or dependent adults are cared for while the person who normally cares for them cannot do so. In many industrial countries, women have traditionally cared for their own children. But in recent years, more and more women have begun working outside the home. The number of families with only one parent has also increased. Because of these changes, many families no longer have an adult at home during the day, and the demand for day care has risen.

**Types of day care for children.** Many working parents enrol their children in a *day-care centre* or *nursery*. This is a nonhome site where a group of children receive adult care and supervision. Parents may also place their children in a *family day-care home*. In family day care, an adult, often called a *childminder*, cares for a small number of children in his or her own home. Usually, this adult is a mother with her own children. Some parents obtain day care by hiring a *sitter* or *nanny*. This is a person who comes to, or lives in, the family home. Other parents rely on relatives to care for their children during the day.

**Day care for school-age children.** Some working parents who have school-age children can be home when the children go to school and when they come home. But many parents are unable to do so, and their children may need day care before and after school.

Before- and after-school day-care programmes may

A preschool nursery gives children a safe environment where they can learn and play and make friends away from home.

Anthea Sieveking, Collections





be located in the school the child attends. Such day care may also occur in a day-care centre, a family day-care home, or the home of a relative or neighbour. In many areas, day care for school-age children is hard to find or expensive. For this reason, numerous children care for themselves before or after school.

**Government support of day care.** In most countries, day-care programmes are run by individuals or nongovernment organizations. Usually, only a few programmes are fully funded by the state.

**Employer-supported day care.** In some countries, many employers offer benefits to help working parents care for their children and other dependants. The most common benefits include part-time working hours, flexible schedules, and unpaid leave. Some employers have day-care centres at the workplace. Others help working parents find and pay for day care outside the workplace.

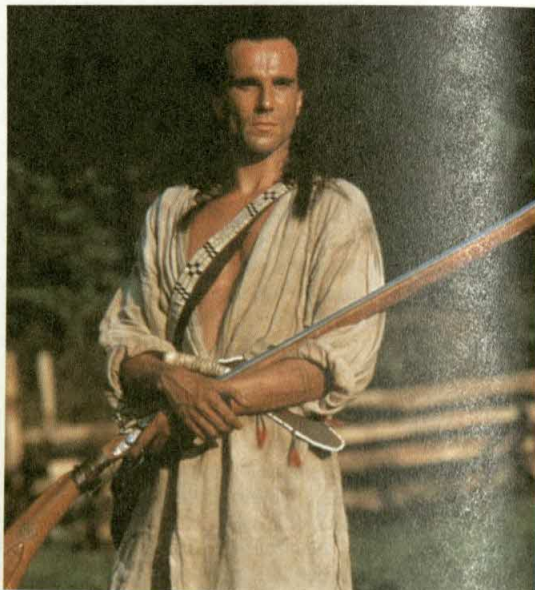
**Choosing a day-care provider for children.** Experts recommend that parents select a day-care provider that is licensed or regulated by the local authority. Many countries do not regulate or license all types of day-care providers. Experts also recommend that the caregivers have special training in childcare and that there are enough carers to provide each child with individual attention. In addition, the site should be safe, the activities and equipment should be appropriate to the children's ages, and parents should be able to visit at any time.

**Day care for the elderly.** Many elderly people are assisted by *home-care aides*. These aides come to the home of elderly adults to help them with personal care and household chores. Some communities have day-care centres for the elderly.

**Day-Lewis, Cecil** (1904-1972), was an Irish-born English poet and novelist. In 1968, Queen Elizabeth II appointed him poet laureate of England.

Day-Lewis was born in Ballintogher, near Sligo, and attended Oxford University in England. During the 1930's, along with W. H. Auden, Louis MacNeice, and Stephen Spender—all friends from Oxford—he gained fame for his poems expressing discontent with society. These poets influenced English verse by writing about modern political and social forces in a direct, informal, and often deliberately vulgar manner. Much of Day-Lewis's later poetry deals with his Irish heritage and memories of his childhood in Ireland. Day-Lewis's *Collected Poems* were published in 1954. His novels include *The Friendly Tree* (1936) and *Starting Point* (1937). His autobiography, *The Buried Day*, was published in 1960. Day-Lewis wrote detective stories under the pen name of Nicholas Blake.

**Day-Lewis, Daniel** (1957- ), is an Irish actor. In 1989, he won the Academy Award for best actor in the film *My Left Foot*, in which he played disabled Irish author and poet Christy Brown. Day-Lewis is widely respected for his ability to transform himself, taking on a wide range of film roles, from street thug in *My Beautiful Laundrette* (1986) to pompous English gentleman in *A Room with a View* (1986). Other film performances include *The Unbearable Lightness of Being* (1988), *The Last of the Mohicans* (1992), and *In the Name of the Father* (1993). Day-Lewis also works in theatre in the United Kingdom, where he has appeared with the Royal Shakespeare Company.



20th Century Fox/Morgan Creek (courtesy Kobal)

**Daniel Day-Lewis** has achieved fame for his versatility, changing his appearance for different film roles, such as Hawkeye in *The Last of the Mohicans*, above.

Daniel Day-Lewis was born in London, the son of the poet and novelist Cecil Day-Lewis. He attended Bristol Old Vic Theatre School.

**Day lily** is a lily plant whose beautiful blossoms, usually yellow or orange, live only from sunrise to sunset. The flowers grow in loose clusters at the top of a leafless stalk 90 to 150 centimetres high. The plant's long smooth leaves spring from the fleshy, fibrous root. The related *plantain lily* resembles the day lily, but it has white and blue flowers.

**Scientific classification.** Day lilies are in the lily family, Liliaceae. The tawny-orange day lily is *Hemerocallis fulva*. The fragrant, or lemon, day lily is *H. flava*.



The lemon day lily, above, produces beautiful flowers in loose clusters at the top of a tall, leafless stalk.



**Day of Atonement.** See Yom Kippur.

**Dayaks.** See Dyaks.

**Dayan, Moshe** (1915-1981), was an Israeli military hero and political leader. He commanded the Israeli forces that won the Arab-Israeli war of 1956, and directed the Israeli victory in a six-day war against Egypt, Jordan, and Syria in June 1967. Dayan became Israel's foreign minister in 1977. He resigned in 1979 because he believed that the government was not doing enough to bring about peace with the Arabs. He was minister of defence from 1967 to 1974, minister of agriculture from 1959 to 1964, and chief of staff from 1953 to 1958.



Moshe Dayan

In 1939, the British who ruled Palestine imprisoned Dayan for his work with the outlawed *Haganah*, a Jewish militia group. He was released in 1941 to fight with the British against the Vichy French. He was wounded during a battle in Lebanon, and lost his left eye. Dayan also fought in the first Arab-Israeli war of 1948. He was born in Deganiya, Palestine.

See also Israel (History).

**Daydream.** See Imagination.

**Daylight saving** is a plan in which clocks are set one hour ahead of standard time for a certain period. As a result, darkness comes one hour later than on standard time. The advantages of this plan include an additional daylight hour for recreation in the evening. In Britain, William Willett started campaigning for daylight saving time in 1907. Britain adopted daylight time as an economy measure in 1916 during World War I. The United States adopted it in 1918. In Britain and Ireland daylight saving is known as *summer time*.

See also Willett, William.

**Dayton** (pop. 182,044) is a leading manufacturing centre in the Midwestern state of Ohio in the United States. For location see **United States of America** (political map). Dayton is called the *Birthplace of Aviation* because Orville and Wilbur Wright, inventors of the first successful aeroplane, lived there. Chief products include nonelectrical machinery and rubber and plastic goods. Wright-Patterson Air Force Base is near the city. Dayton was founded in 1796. It has a council-manager form of government.

**DC.** See **Electric current** (Direct and alternating current).

**DDT** is an insecticide that has been widely used on crops for pest control. The three letters come from its chemical name, *d*-chloro-*d*-phenyl-*t*-chloroethane. DDT is a greyish-white powder that, when used for pest control, is mixed with other substances.

DDT kills insects by affecting the nervous system. It differs from most other insecticides because it lasts a long time. DDT decays slowly and appears in plants and in animals that eat the plants. It also appears in human beings because it is absorbed into the body tissues from the animals and plants that people eat.

Large-scale application of DDT kills useful insects as well as harmful ones, and it may endanger other animal life, including birds and fish. It may also contaminate the food that people eat. In 1972, the United States Environmental Protection Agency banned almost all uses of DDT. But DDT is still used in other parts of the world.

DDT was first prepared as an insecticide by Paul Müller, a Swiss chemist, in 1939 (see Müller, Paul H.). It became well known during World War II (1939-1945), when the United States Army used it to fight an epidemic of typhoid fever in Naples, Italy. The army used DDT as a means of destroying body lice, which carry the disease.

**De facto segregation.** See **Segregation** (De facto segregation).

**De jure segregation.** See **Segregation** (Jim Crow laws).

**Deacon** is one of the classes or ranks of Christian clergy. The term also refers to members of the laity assigned to help ministers and priests in such tasks as preaching and helping the sick and needy. The word *deacon* comes from *diakonos*, a Greek word that means *servant*. The office of deacon is referred to as the *diaconate*.

In the Anglican, Eastern Orthodox, and Roman Catholic churches, the diaconate is mainly a stage of a year or less that precedes priesthood. These churches now also have deacons ordained to the diaconate as a lifetime vocation. These deacons assist in church work, especially if there is a shortage of priests. In many Protestant churches, deacons are lay members who help meet various needs of their congregation. The Anglican church and many Protestant churches have women members of the diaconate called *deaconesses*.

**Dead reckoning.** See **Navigation** (Dead reckoning); **Aeroplane** (Dead reckoning).

**Dead Sea** is a saltwater lake in southwestern Asia. Its shore, which lies about 399 metres below sea level, is the lowest place on the surface of the earth. The Dead Sea is the saltiest body of water in the world. It is about nine times as salty as the ocean. The lake lies at the mouth of the River Jordan and forms part of the border between Israel and Jordan.

The salty waters of the Dead Sea appear smooth and sparkling. Rocky and barren land surrounds the lake, and steep, brightly coloured cliffs rise above its eastern and western banks. The lake is called the Dead Sea because few plants and no fish except brine shrimp live in its waters. In addition, little plant life grows in the salty soil around the Dead Sea.

The Dead Sea lies in the Ghor, a deep *fault* (break) in the earth's crust. The lake covers about 1,040 square kilometres. It is 18 kilometres wide at its widest point and about 80 kilometres long.

A peninsula called Al Lisan juts into the Dead Sea from its eastern shore. This peninsula divides the lake into a large northern basin and a smaller southern basin. The lake's deepest part is in the northern basin. In this area, the lake bottom lies 400 metres below the surface and about 799 metres below sea level.

Since the early 1900's, the water level of the Dead Sea has been slowly falling. The region receives less than 100 millimetres of rain annually. The River Jordan and several streams pour relatively fresh water into the lake.



54 Dead Sea

The fresh water mixes with salty water at the surface. However, extreme heat in the area causes this water to evaporate rapidly. As a result, the Dead Sea never grows less salty. The high salt content of the water provides great buoyancy, enabling swimmers to float with ease.

The Dead Sea contains large quantities of minerals, including common salt (sodium chloride), bromine, calcium chloride, and potassium chloride. An Israeli company called the Dead Sea Works extracts the minerals from the water for use in making such products as table salt, fertilizer, and drugs.

At the southern end of the Dead Sea, a network of dikes forms shallow pools that cover more than 100 square kilometres. These pools evaporate and leave behind mineral solids, which are then refined by the Dead Sea Works. Some people believe that bathing in the Dead Sea is healthful because of its high mineral content. Several health resorts in the area provide facilities for bathers.

The Dead Sea was probably formed millions of years ago when the Arabian Peninsula and the African continent shifted and formed the Great Rift Valley (see **Great Rift Valley**). The Dead Sea is mentioned in the Bible as

the *Salt Sea* (Gen. 14:3). The ancient cities of Sodom and Gomorrah stood near the lake (see **Sodom and Gomorrah**).

Columns of salt rock on the shore of the Dead Sea may have been the basis for the Biblical story of Lot's wife (see **Lot**). Lot's wife was turned into a pillar of salt as punishment for disobedience to God (Gen. 19:26). Ancient manuscripts known as the *Dead Sea Scrolls* were found in caves near the Dead Sea. Most of these scrolls date from about 100 B.C. to about A.D. 70 (see **Dead Sea Scrolls**).

See also **Israel** (Mining; picture); **Asia** (picture).

**Dead Sea Scrolls** are ancient manuscripts from Palestine. The scrolls were found in desert caves near the northwestern shore of the Dead Sea (see **Dead Sea** [map]). The first group of scrolls was discovered in 1947 by shepherd boys in a cave in the *Wadi Qumran* (Qumran Valley). In the late 1940's and early 1950's, archaeologists and Bedouins found 10 more caves containing ancient writings.

The discoveries consist of scrolls and fragments of hundreds of documents. Most of the manuscripts are made of leather or papyrus, some written as early as 200 B.C. They were part of a library that many scholars believe belonged to a group of the Essenes, a Jewish sect (see **Essenes**). This group probably lived from about 150 B.C. to A.D. 68 in a settlement near the caves where the scrolls were found.

The Dead Sea Scrolls include all the books of the Old Testament except Esther. A few of the books were found in good condition, and are in nearly complete form. They are the oldest known manuscripts of any books of the Bible. The scrolls also include some fragments of the *Septuagint*, which is the earliest Greek translation of the Old Testament, and parts of the Book of Job written in Aramaic. In addition, the scrolls include parts of some books of the Apocrypha written in Hebrew, Aramaic, and Greek.

The Dead Sea Scrolls also include writings of the Qumran community itself. The writings provide a rare picture of one group of Palestinian Jews about 2,000 years ago. Two manuscripts tell how the community organized its life. They indicate how one became a member and why. They also contain the rules that governed daily life in the community. Another manuscript gives directions for conducting the final battle that the community awaited, the War of the Sons of Light against the Sons of Darkness. Some texts record the prayers of the community. The Hymn scroll is a collection of hymns somewhat like the Book of Psalms. Other manuscripts are commentaries on the books of the Bible.

Caves near the western shore of the Dead Sea were excavated in the 1950's and 1960's. They also contained parts of Biblical and other documents. These texts date largely from a later historical period that preceded and included the second Jewish revolt against the Romans from A.D. 132 to 135.

See also **Bible** (picture: The Dead Sea Scrolls).

**Deadbolt.** See **Lock** (How door locks work; picture).

**Deadly nightshade** is a bushy plant that supplies several drugs. The most important drug obtained from the plant is *atropine*. Deadly nightshade comes from southeastern Europe and western Asia. It is now found throughout Europe on dry limestone or chalk soils.

Dead Sea

Area: 400 sq.mi. (1,040 km<sup>2</sup>)

Elevation: 1,310 ft. (399 m) below sea level

Deepest point: 1,312 ft. (400 m)

- Land below sea level
- Historic site
- Road
- Railway







**Deadly nightshade flowers, leaves, and berries**

Deadly nightshade is a stout bush about 1.5 metres high. It has dull green, oval leaves, and large, drooping, bell-shaped flowers that are blue-purple or dull red. The fruit is a glossy black berry, the size of a small cherry, surrounded by a broad-lobed *calyx*. See **Flower** (The parts of). People have died from eating the berries. Vinegar is a simple first aid remedy for deadly nightshade poisoning, but a doctor should be called immediately if the berries have been swallowed.

Deadly nightshade drugs are taken from the roots, but all parts of the plant contain the drugs. They are an important antidote for poisoning with certain insecticides and fungi. They can be used to relieve colic, and various intestinal disorders. Ophthalmologists sometimes use these drugs to relax eye muscles and to cause the pupil to dilate (expand). The drugs should be used only under the direction of a doctor.

**Scientific classification.** Deadly nightshade is in the nightshade family, Solanaceae. It is *Atropa belladonna*.

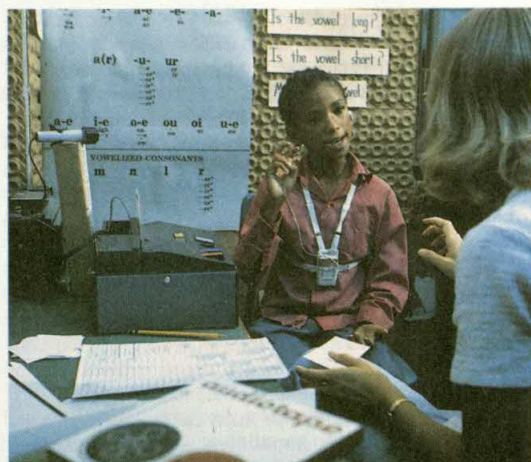
**Deafness** is usually defined as the inability to hear and understand speech. But in many countries, there is no legal definition of deafness and experts do not completely agree on when to use the term.

Hearing specialists generally distinguish between deafness and *hearing impairment*. People with impaired hearing can usually hear and understand at least some speech, especially when it is loud enough. However, they may be unable to hear some other sounds, such as doorbells or high musical notes. In addition, the quality of any sounds they do hear may be distorted.

Deaf children and children with severe hearing impairments have tremendous difficulty learning to speak. Normally, children learn to speak by imitating the speech of others. But deaf children cannot hear speech. Many deaf people never learn to speak well enough to be understood. They use sign language and other special techniques to communicate.

Defective hearing is a common physical disability in most countries. About seven per cent of the people have a noticeable hearing disorder, and about one per cent are deaf.

Many deaf people earn university degrees, and most deaf men and women support themselves. Deafness



**Deaf students** can be taught to communicate with the assistance of specially trained speech therapists. The therapist shown above is working with a youngster at a school for the deaf. The therapist is teaching the child how to make vowel sounds. The student is learning with the help of a powerful hearing aid.

need not hinder achievement in a wide variety of occupations. The famous German composer Ludwig van Beethoven wrote some of his finest music after he became deaf.

### Types of hearing disorders

There are two major types of hearing disorders, *conductive disorders* and *sensorineural disorders*. Some people suffer a combination of these conditions called a *mixed hearing loss*.

Conductive disorders result from interference with the transmission of sound through the outer ear or the middle ear. Sound normally enters the outer ear and passes down the ear canal to the *tympanum* (eardrum). This thin membrane vibrates in response to sound and activates three tiny bones, called *ossicles*, in the middle ear. The ossicles transmit the vibrations to the inner ear. Most cases of conductive hearing loss are due to diseases that prevent the ossicles from functioning properly.

Sensorineural disorders involve some defect in the inner ear or the *auditory nerve*, which leads from the inner ear to the brain. The inner ear contains the actual organ of hearing, called the *organ of Corti*. This organ converts the vibrations transmitted to the inner ear into electrical impulses, which the auditory nerve carries to the brain. Damage to any of these tissues can be caused by many factors, and it cannot be repaired.

### Causes of hearing disorders

**Diseases** cause most cases of conductive hearing loss. The leading cause of such disorders is *otitis media* (infection of the middle ear). In otitis media, a common cold or some other infection spreads to the middle ear and causes it to fill with fluid. The pressure of this fluid reduces the ability of the eardrum and ossicles to transmit vibrations. Otitis media occurs most commonly during early childhood and can lead to serious hearing loss if not treated promptly.



The other major cause of conductive hearing loss is *otosclerosis*, a disease of the ossicles. In this disorder, a bony growth forms around the base of the *stapes*, the bone next to the inner ear. The growth keeps the stapes from moving and so prevents it from passing on vibrations to the inner ear. Doctors believe otosclerosis is hereditary. It may begin to affect hearing at any age but the disorder is usually not detected until the teenage years or later.

Some diseases can cause sensorineural disorders. *Meningitis* and other diseases accompanied by a high fever can severely damage the inner ear and the auditory nerve. A disorder of the inner ear called *Ménière's disease* also causes hearing loss, especially among people over 40. This disorder, which affects millions of people, often disturbs the sense of balance.

**Birth defects** account for many cases of sensorineural deafness or hearing impairment. Some people are born with inherited defects in their *auditory* (hearing) systems. Other inherited conditions may lead to hearing loss later in life.

A woman who has German measles during pregnancy may give birth to a child with a hearing defect. German measles, especially if it strikes during the first three months of pregnancy, may interfere with the development of the child's ears and nervous system.

A condition called *Rh disease* can cause a child to be born with a hearing disorder. The blood of some unborn children contains a substance called the *Rh factor*, which is not in the mother's blood. The mother's body may produce substances that attack the Rh factor and damage the baby's auditory system. See **Rh factor**.

**Environmental factors**, such as accidents and exposure to loud noise, can damage a person's hearing. A hard blow to the head can cause permanent hearing loss. Such injuries may affect the eardrum, the bones of the middle ear, or even parts of the inner ear. Exposure to loud noises can lead to serious hearing loss by damaging the organ of Corti. Extremely loud noises, such as explosions or gun blasts, can produce sudden deafness. In many of these cases, however, the victim eventually recovers much of the lost hearing.

Exposure to loud noise over a long period of time can gradually cause permanent loss of hearing. Many people who work in extremely noisy factories eventually

suffer considerable hearing loss. Listening for long periods to the loud music played by many rock music bands can also damage hearing. In addition, many doctors believe that prolonged exposure to loud noises is a major cause of *tinnitus* (ringing in the ears). All loud sounds should be avoided if possible, or people should use ear plugs or other devices to muffle them.

**Aging.** Loss of hearing is one of the most common disorders among older people. About two-thirds of people over 65 years of age experience some loss of hearing. In most countries, more than 20 per cent of elderly people have hearing problems severe enough to seriously impair their ability to communicate. Hearing loss in old age, called *presbycusis*, may result from illness or exposure to noise earlier in life. Some hearing specialists believe aging may also cause changes in the auditory system or in the brain that reduce hearing ability.

### Living with hearing disorders

**Detection of hearing problems.** Experts called *audiologists* are specially trained to detect and diagnose hearing problems. An audiologist uses an electrical instrument called an audiometer to test a person's hearing in a soundproof room. There are two main types of audiometers: *pure-tone audiometers* and *speech audiometers*. Pure-tone audiometers use simple vibrations of various frequencies and intensities to measure hearing. Speech audiometers use spoken words or sentences.

Audiologists can also measure hearing ability without the conscious participation of the person being tested. They perform these tests by measuring alterations in brain waves and other bodily responses to sound. Such responses make it possible to test an infant's hearing. A child's hearing should be tested within a few days after birth if premature birth or some other condition suggests a possible hearing disorder. Many schools conduct regular hearing tests. Children found to have a hearing loss are referred to a specialist clinic for complete testing.

**Medical treatment.** Doctors can restore hearing partially or completely in many cases of conductive hearing loss. Doctors use penicillin and other antibiotics to treat otitis media. In severe cases of this infection, a small incision is made in the eardrum to drain fluids that have collected in the middle ear.

Some conductive disorders are treated by surgery. For example, a ruptured eardrum can be repaired surgically. An operation called *stapes mobilization* can restore the ability of the middle ear to transmit sound in patients suffering from otosclerosis. This operation frees the stapes from the bony growth that has trapped it. In some cases, the surgeon completely removes the stapes and replaces it with an artificial device. Such an operation is called a *stapedectomy*.

Most sensorineural disorders cannot be treated medically because damage to the inner ear or auditory nerve is permanent. However, a surgical operation called a *cochlear implant* can be helpful in some cases that involve damage to the cochlea, the part of the inner ear that contains the organ of Corti. In this operation, the surgeon implants a device that converts sounds into electric signals. These signals are picked up by the auditory nerve and transmitted to the brain. Such an operation may enable a profoundly deaf person to hear



**Testing for hearing disorders** is usually done by trained experts called *audiologists*. The audiologist shown above is using a device called an *audiometer* to test a child's hearing.





A special telecommunications device, called a TDD, enables a deaf person to make and receive telephone calls. The message appears on a screen or is printed on paper.

sounds and understand some speech. However, many doctors believe that the risks and cost of cochlear implants may outweigh their benefits.

#### Special aids and communication techniques.

Many hearing-impaired people benefit greatly from the use of electronic hearing aids to amplify sound. A hearing aid works much like a telephone. It converts sound to electrical energy, amplifies the energy, and then changes the energy back into sound. Hearing aids work successfully for people with conductive disorders, but these devices may have only limited value in cases of sensorineural impairment. Amplification alone cannot make speech understandable to most victims of sensorineural disorders, though it may provide some improvement in hearing. An audiologist can recommend the proper hearing aid for a patient.

Many people who use a hearing aid also use *lip reading* and *manual communication* to help them communicate. Lip reading involves watching the movements of the speaker's lips. In manual communication, people communicate primarily with their hands. Some deaf people rely entirely on lip reading and manual communication because a hearing aid cannot help them.

Manual communication usually involves both *finger spelling*, in which each letter of the alphabet is represented by a different hand signal, and *sign languages*, in which hand signals stand for objects and ideas (see *Sign language* [picture]). Major sign languages used in the world include British Sign Language (BSL) and American Sign Language (also called ASL or Ameslan). Deaf people use manual communication to converse with individuals who understand finger spelling and sign language. They also communicate by speaking and lip reading, or by writing. Sometimes they use professional interpreters who hear normally and know manual communication.

Some deaf people also use other aids in their daily lives. For example, in some countries dogs serve as "hearing ear dogs" for the deaf. These dogs alert their masters to various specific sounds, such as alarms, doorbells, and a baby's crying. A number of devices for the deaf give information through visual signals. Examples are doorbells, alarm clocks, and "baby alarms" which produce a flashing light as a warning.

Deaf individuals can make and receive telephone calls by using a text-telephone or TDD (Telecommunications Device for the Deaf). These devices plug into the

telephone wall-socket in the usual way. Alternatively, the connection is sometimes made acoustically by placing the telephone handset into a pair of soft rubber cups on the top of the text-terminal.

For many years, both the caller and the person receiving the call had to have a text-terminal. Both parties type in turn and can read both parts of the conversation. In the early 1980's, Relay or Linkup services were set up to enable deaf people to contact hearing people with just an ordinary telephone. A specially trained operator connects the call and types the hearing person's speech for the deaf person. The deaf person can often choose to speak or type the reply. Other systems allow short text messages to be sent using the keypads of touch-tone telephones.

Deaf people can enjoy TV and films if *subtitles* (printed dialogue) appear on the screen. During the 1970's and 1980's, many of the world's television services began broadcasting *teletext* (information in print), which greatly benefited deaf people. Such television companies reserve part of the TV signal for the broadcasting of teletext. In the 1980's, many television stations in the world began *optional subtitling* of some of their programmes over this part of the signal. The subtitles appear only on sets that have a special modification.

**Education and training.** Many deaf children receive their primary and secondary school education in special schools or in classes that have teachers specially trained to instruct them. Children with impaired hearing may attend special classes, or they may take part in classes with hearing children and obtain expert assistance.

Two main methods of training deaf children to communicate are the *oralist method* and *total communication*. In the oralist method, children are taught to speak and to lip-read. In total communication, they learn manual communication as well as speech and lip reading.

Deaf children can learn manual communication more easily than they can learn to speak. Supporters of the oralist method claim that children who learn manual communication will rely on it and never develop their potential for speech. However, supporters of total communication believe that deaf children should learn every means of communication—and use the methods that best meet their individual needs.

Teaching deaf children to speak requires special techniques. Normal speech development depends on hearing speech, but deaf children must use their senses of sight and touch to learn to speak. They watch their teacher make a vocal sound. They also touch the teacher's face and throat in order to feel the vibrations and the flow of breath involved in making the sound. Then they try to produce the same vibrations and breath effects themselves.

After deaf students leave school, they may attend a normal university. Gallaudet University, in Washington, D.C., U.S.A., is the world's only university exclusively for deaf people.

Modern methods of treating hearing disorders and of educating deaf students enable deaf people to lead fulfilling lives. Deaf men and women have demonstrated their ability to do almost any kind of work. However, some deaf people still have difficulty finding jobs that are suited to their education and training. Many countries have charitable organizations, such as a national as-



sociation of the deaf, to promote the education, training, employment, and social life of deaf people and to fund research to aid deaf people.

**Related articles** in *World Book* include:

Audiology	Hearing aid
Bell, Alexander G.	Keller, Helen A.
Ear	Lip reading
Handicapped	Sign language

**Deakin, Alfred** (1856-1919), an Australian politician and statesman, was prime minister of Australia three times—from 1903 to 1904, from 1905 to 1908, and from 1909 to 1910. Before 1901, he worked hard for federation. As prime minister, he shaped many federal policies on such issues as defence, immigration, and social services.

Deakin was born in Melbourne and educated at Melbourne University. He was a member of the Liberal Party. He began his political career in 1880, when he entered the Victorian parliament. He later became solicitor general. After federation, he was appointed federal attorney general.

**Dean, Dixie** (1908-1980), was one of the best centre-forwards in English soccer. He played for Everton from 1925 to 1938. He was particularly noted for his accuracy in heading. Dean scored 60 goals in 39 matches during the 1927-1928 season, breaking the Football League scoring record. He scored a total of 379 goals for his clubs, which included Tranmere Rovers, Everton, and Notts County. He was born at Birkenhead in north-west England.

**Dean, James** (1931-1955), was an American film actor. He became famous for his intense, brooding portrayals of discontented, rebellious young men. Dean starred in only three films—*East of Eden* (1955), *Rebel Without a Cause* (1955), and *Giant* (1956). He died in a car accident at the age of 24. After his death, he became an idol to young people in many parts of the world. They considered Dean a symbol of their frustrations because of the characters he portrayed.

James Byron Dean was born in Marion, Indiana. He studied acting at the University of California at Los Angeles and at the Actors Studio in New York City. Dean acted in TV dramas before beginning his film career. He also was in two Broadway plays, *See the Jaguar* (1952) and *The Immoralist* (1954).

**Dearborn** (pop. 89,286) is a manufacturing centre near Detroit in the state of Michigan, part of the Great Lakes region of the United States. The headquarters and main plants of the Ford Motor Company are in the city. Dear-

born's chief products include cars, steel, and heating and air-conditioning equipment. Greenfield Village, a group of historical buildings, and the Henry Ford Museum attract many visitors. The village of Dearborn was founded in 1893. It became a city in 1927. Dearborn has a mayor-council form of government.

**Death** is the end of life. Every living thing eventually dies, but human beings are probably the only creatures that can imagine their own deaths.

Most people fear death and try to avoid thinking about it. However, people's awareness of death has been one of the chief forces in the development of civilization. Throughout history, people have continually sought new medical knowledge with which to delay death. Philosophers and religious leaders have tried to understand the meaning of death. Some scholars believe that much human progress results from people's efforts to overcome death and gain immortality through lasting achievements.

**Medical aspects of death.** Scientists recognize three types of death. These types are *necrobiosis*, *necrosis*, and *somatic death*.

*Necrobiosis* is the continual death and replacement of individual cells through life. Except for nerve cells, all the cells of an organism are constantly being replaced. For example, new skin cells form under the surface as the old ones die and flake off.

*Necrosis* is the death of tissues or even entire organs. During a heart attack, for example, a blood clot cuts off the circulation of the blood to part of the heart. The affected part dies, but the organism continues to live unless the damage has been severe.

*Somatic death* is the end of all life processes in an organism. A person whose heart and lungs stop working may be considered *clinically dead*, but somatic death may not yet have occurred. The individual cells of the body continue to live for several minutes. The person may be revived if the heart and lungs start working again and give the cells the oxygen they need. After about three minutes, the brain cells—which are most sensitive to a lack of oxygen—begin to die. The person is soon dead beyond any possibility of revival. Gradually, other cells of the body also die. The last ones to perish are the bone, hair, and skin cells, which may continue to grow for several hours.

Many changes take place after death. The temperature of the body slowly drops to that of its surroundings. The muscles develop a stiffening called *rigor mortis*. The blood, which no longer circulates, settles and produces reddish-purple discoloration in the lowest areas of the body. Eventually, bacteria and other tiny organisms grow on the corpse and cause it to decay.

**Defining death.** Traditionally, a person whose breathing and heartbeat had stopped was considered dead. Today, however, doctors can sometimes prolong the functioning of the lungs and heart by artificial means. Various machines can produce breathing and a heartbeat even in a patient whose brain has been destroyed. Developments in such life-support machines have led to a new definition of death called *brainstem death*. A diagnosis of brainstem death is reached only after repeated medical tests have confirmed that the brain is no longer functioning. Life-support is then withdrawn and the heartbeat ceases.



Alfred Deakin



James Dean



In a condition of near-death called Persistent Vegetative State (PVS), patients are unable to think, speak, feel or hear. They open their eyes and have cycles of sleeping and waking two to three weeks after falling into the state. There is no recovery from PVS.

**The right to die.** Many people believe that doctors should use every means to maintain life as long as possible. But others feel that hopelessly ill or injured patients, particularly those who are very old, should not be subjected to invasive treatments just to gain a little more time. Instead, they should be made comfortable and allowed to die with dignity.

Some people believe that hopelessly ill patients should not only have the right to refuse treatment, but also to be put painlessly to death if they desire. They contend that each person has the right to control his or her life and to determine the time of his or her death. Others maintain that this right should be extended to the families of dying patients who are no longer capable of expressing their own desires. They argue that the family and doctor should be able to painlessly end the patient's suffering. Putting hopelessly ill people to death—with or without their requesting it—is called *euthanasia*, or *mercy killing*. It is illegal in most countries.

In 1993, the lower house of the Dutch parliament voted to legalize euthanasia. Mercy killing is considered lawful in the Netherlands when a patient suffering unbearable pain for which there is no remedy repeatedly asks to be allowed to die.

**Attitudes about death** have changed during the 1900's. About 1900, the majority of deaths were those of children who died of diphtheria, pneumonia, or some other infectious disease. Most people died at home, surrounded by their families. People were familiar with dying, and viewed death as a natural part of life.

Today, most people in industrial nations die from heart disease, cancer, stroke, or other diseases associated with aging. As a result, about 95 per cent of all children reach adulthood without experiencing a death in their family. In addition, most deaths now occur in hospitals. Therefore, many young people have never been present at someone's death. This lack of experience makes it difficult for many people to talk openly about death or to be with a dying person.

The increasing number of deaths among the elderly has also affected attitudes about death. Many people have come to view the elderly as having "lived out their lives," and may experience the death of an elderly person as a minor emotional event. But the death of a child or a young adult is considered unexpected and unjust and may have long-lasting emotional consequences.

Traditionally, people have confronted death within a set of religious beliefs that gave it meaning apart from the natural world. Most religions teach that there is something in people that can survive the death of the body. Buddhists, Hindus, Jains, and Sikhs believe that after death the soul is reincarnated in another body, human or animal, and that a person's moral character during life will determine what he or she will be reborn as in the next life. They believe that reincarnation happens many times before the soul is sufficiently purified to be freed from this cycle of death and rebirth. Christians and Muslims took from Judaism the idea of a life after death in which a person's soul is judged according

to his or her deeds. They believe that the good go to a life of eternal bliss in heaven or paradise, and the wicked are condemned to eternal suffering in hell. Most other religions have concepts of a journey after death to a place where the dead continue to exist.

All cultures have customs and rituals for mourning and for disposing of the dead. These rites are sometimes long and elaborate, and often there are conventions concerning such matters as what clothing should be worn and what food should be provided. Observing these rituals helps people begin to face and deal with the grief that accompanies the loss of a loved one.

One convention observed by most cultures is that the body of a dead person should be publicly displayed for a certain time. This makes it possible for friends and relatives to make a form of personal farewell to the dead and so begin the process of acceptance and adjustment. It also ensures that the death is known to all and cannot be denied. A further administrative formality observed in most countries is a requirement of a death certificate, signed by a medical practitioner, verifying the fact of death and stating the cause. The certificate is usually necessary before a body can be disposed of. It helps to ensure that there are no suspicious circumstances associated with the death that could be concealed, and begins the process by which the dead person's property may be legally transferred to people who are still alive.

During the mid-1900's, many psychologists and other people became interested in the special emotional needs of dying people. For example, studies showed that friends, relatives, and even doctors and nurses avoided dying patients because of their own feelings about death. As a result, many critically ill patients suffered greatly from loneliness. To help solve this problem, a number of medical schools, hospitals, colleges, and secondary schools and churches began to give courses designed to teach people about death and to be more responsive to the needs of the dying.

**Related articles.** See *Funeral customs* and its list of *Related articles*. See also the following articles:

Euthanasia	Immortality	Resurrection
Hospice	Reincarnation	

**Death adder** is among Australia's most dangerous snakes. Death adders are stout-bodied, viperlike, with broad heads, small necks, and thin, short tapering tails. Most of them are less than a metre long. But they have



**A death adder** usually hides in sand or under fallen leaves during the day.



large fangs and potent venom. Most death adders are grey or brown and have irregular darker crossbands. They usually spend the day hiding in sand or under fallen leaves. They hunt at night and eat lizards and small mammals. They live in New Guinea and most parts of the Australian mainland.

**Scientific classification.** Death adders are in the family Elapidae. They are *Acanthophis antarcticus*.

**Death penalty.** See Capital punishment.

**Death rate.** See Birth and death rates.

**Death Valley** lies chiefly in east-central California, U.S.A. A small part of it extends into Nevada. In 1849, a group of pioneers named the valley after they crossed its desolate environment. It became part of the Death Valley National Monument, set up in 1933.

Death Valley is a deep trough, about 209 kilometres long and from 10 to 23 kilometres wide. The lowest elevation in the Western Hemisphere is near Badwater in Death Valley. It lies 86 metres below sea level. The Panamint Mountains stand west of the valley. Telescope Peak in the Panamint range is 3,368 metres high. The Amargosa Range, composed of the Grapevine, Funeral, and Black mountains, rises to the east.

The valley is a *graben*—a block in the earth's surface, dropped down by faults that form its east and west walls. *Faults* occur when the earth's rocky outer shell

breaks and the rock along the break slips. Erosion of the steep cliffs has formed beautiful canyons. In the northern part of the valley is Ubehebe Crater, a small volcano on the west side fault. Flows of lava issue from the faults in the southern part of Death Valley.

During glacial times, the climate was moister, and a large lake occupied Death Valley. Today, rainfall averages about 5 centimetres a year there. The highest temperature ever recorded in the United States, 57 °C, was reported there on July 10, 1913. Summer temperatures of 52 °C are common. The valley's geological attractions and warm winter sunshine have made it a popular winter-resort area. Plants in the valley include the creosote bush, desert holly, and mesquite. Wildlife is equally varied and includes bobcats, coyotes, foxes, rats, rabbits, reptiles, and squirrels.

Borax deposits were discovered in Death Valley in 1873. Mining began in the early 1880's, and 20-mule teams hauled the borax out of the valley. Prospectors also discovered copper, gold, lead, and silver in the nearby mountains. Mining towns sprang up, with such colourful names as Bullfrog, Greenwater, Rhyolite, and Skidoo. The towns died when the ores were exhausted. Today only cluttered debris remains.

See also **United States** (picture).

**Death's-head moth** is a large moth with a thick, hairy body. Many superstitions arose because of the skull-like pattern on its body. The death's-head moth is a type of *hawk moth* (see **Hawk moth**). One species lives in Africa and southern Europe, and adults often migrate to northern Europe. Other species live in India and Southeast Asia. Death's-head moths enter beehives to eat honey and may squeak loudly when disturbed. The caterpillar is bright yellow with violet stripes and blue spots. It feeds on the leaves of such plants as potato, aubergine, and tomato.

**Scientific classification.** Death's-head moths belong to the family Sphingidae. The African species is *Acherontia atropos*. The Asian species are *A. lachesis* and *A. styx*.

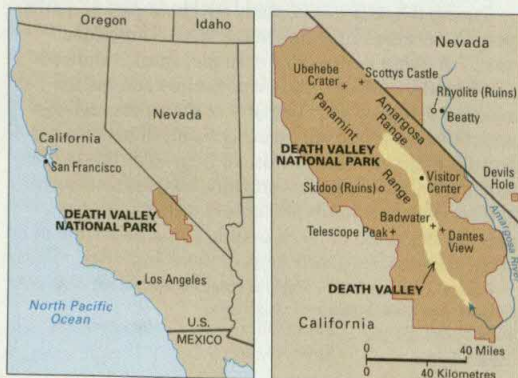
**Deathwatch** is a name given to several kinds of small brownish beetles that have the strange habit of knocking their heads against wood. This action produces a peculiar ticking or rapping sound. Superstitious people believe that the rapping, heard in the quiet of the night, foretells death in the house. The beetles burrow into furniture and woodwork and are often destructive.

**Scientific classification.** Deathwatch beetles belong to the family Anobiidae.

**DeBakey, Michael Ellis** (1908- ), an American surgeon, won fame for his work with the heart and for his contributions to techniques used to replace damaged blood vessels, including the coronary bypass operation. In 1967, DeBakey and American surgeon Adrian Kantrowitz successfully implanted the first *assisting heart*. Inserted into the chest, this machine helps a weak heart pump blood until either the heart recovers or surgeons transplant another person's heart. DeBakey also worked on the development of an artificial heart.

DeBakey became the first person to surgically repair an *aneurysm*, a condition in which the wall of a blood vessel weakens and balloons out. He replaced the weakened part of the vessel with another blood vessel (see **Aneurysm**). He later developed artificial blood vessels.

DeBakey was born in Lake Charles, Louisiana, and



**Location of Death Valley**



**Death Valley** is in California, U.S.A. The valley's Badwater area, above, lies at the foot of the Panamint Mountains.



earned an MD from Tulane University in 1932. He became head of the Department of Surgery at Baylor University in 1948 and president of the Baylor College of Medicine in 1969.

**Debate** is a series of formal spoken arguments for and against a definite proposal.

A debate differs from a discussion, though both are fundamental activities in a democracy. *Discussion* is the process by which a problem is recognized and investigated and then solutions explored. *Debate* is the process by which the best solution (in propositions of policy) or appraisal (in propositions of fact) is approved and adopted. Discussion begins with a problem, but debate begins with a proposed solution to a problem. A typical discussion might be, "What is wrong with student activities at Main School?" Suppose this discussion were held, and the decision was that student activities at the school were not properly guided. A debate could then be held. To select the best solution to the problem of guidance, a logical subject for the debate might be, "Resolved, that a combined staff-student board should be established to control all activities of Main School."

**The formal debate.** In formal debating, the same number of persons speak for each side. They have the opportunity to reply directly to opposing speakers. Affirmative and negative speakers usually alternate, and all the speeches are limited in time. In informal (as in conversation) and in legislative debating, though there is the same opportunity to reply to opposing speakers, the speeches are not necessarily limited in time. There may be no attempt to alternate opposing speakers, and the number of speakers on each side may be unequal.

**Propositions.** Subjects for debates are expressed in the form of propositions. A proposition is a carefully worded statement that makes clear the positions of both the affirmative and negative sides.

Propositions should be:

- (1) Appropriate to the knowledge, experience, and interests of both speakers and audience.
- (2) Debatable—that is, not obviously true or false. The statements should involve an honest difference of opinion, with arguments and evidence on both sides.
- (3) Phrased in the affirmative. Positive statements prevent confusion by making the issue clear-cut.
- (4) Restricted to set forth only one idea. This policy keeps the debate within narrow limits.
- (5) Worded clearly. The words should be ones that can be defined exactly, so the debate does not become a mere quibble over the meaning of words.
- (6) Worded in such a way that they do not assume to be true. The following would be a proposition to avoid, "Resolved, that the inefficient committee system of Parliament should be reorganized." The word *inefficient* would bring on a flood of arguments that could confuse the real debate issue.

There are two kinds of propositions: (1) those involving fact and (2) those involving policy.

**Propositions of fact** try to answer the question, "Is this true?" Examples are:

"Resolved, that the expenditures of the advertising department of the XYZ Manufacturing Company during the last year were wasteful."

"Resolved, that television soap operas have beneficial effects on listeners."

"Resolved, that John Jones did a good job as chairman of the student council."

**Propositions of policy** attempt to answer the question, "Should we change?" Examples are:

"Resolved, that treaties should be ratified by a majority vote in both houses of Parliament."

"Resolved, that uniform marriage and divorce laws should be adopted throughout Europe."

"Resolved, that a system of proportional representation should be adopted for all parliamentary elections."

**Other good debate subjects** might be:

- (1) Trial by jury should be abolished in criminal cases.
- (2) The Prime Minister should be elected for one term of two years only.
- (3) The United Nations should be granted more power to settle international problems.
- (4) The state should own and operate all radio and television broadcasting stations.
- (5) The city of ----- should own and operate its electric light and power plant.
- (6) Capital punishment should be abolished.
- (7) European Community states and the British Commonwealth should establish joint citizenship for their citizens.
- (8) National governments should be replaced by membership in a world government.
- (9) Competitive sports in schools and colleges should be abolished.
- (10) All secondary schools should provide a four-year course in the basic sciences.

**Analysis.** After a subject has been selected and the proposition carefully worded, the next step is analysis of the proposition by both debating teams. Analysis of the proposition begins with a broad understanding of it. As a team member, you should know at least as much about your opponents' case as you know about your own side.

Good debaters study the origin and history of a proposition, define its terms, and survey carefully all the arguments and evidence for and against it. After a broad understanding is gained, the debaters have to decide which arguments are *pertinent* (closely related and worthy of being included) and which are *irrelevant* (not closely related, and should be excluded). The areas of agreement and disagreement in the proposition are found by this process. The arguments are narrowed down to points on which the affirmative says "yes" and the negative says "no." This argumentative process is called *finding the issues*.

**The issues.** The chief points of difference between the affirmative and the negative are the *main issues*. These may have divisions called *subordinate issues*. There must be a clash of opinion on both the main and the subordinate issues. A good way to help find the issues is to list the opposing arguments in parallel columns. In the subject "Trial by jury should be abolished in criminal cases," a listing of opposing arguments might lead to the following main and subordinate issues:

- I. Would the abolition of juries in criminal cases lead to a fairer and more efficient system of justice?
  - A. Would replacing the jury with legally qualified judges make decisions more accurate and consistent?
  - B. Would trials be shorter and therefore more efficient?



because time would not be taken up in empanelling the jury?

- C. Would using lay assessors with professional judges help to maintain the public's confidence in a fair legal system?

**II. Would the abolition of juries in criminal cases mean that defendants would not get a fair trial?**

- A. Would replacing juries with professional judges mean that a person would no longer be tried by his 'peers'?
- B. Would the abolition of juries increase the power of the police in the criminal process?
- C. Would the public see the abolition of juries as one more way in which the ordinary person is being excluded from public life?

**The evidence.** After the issues have been determined, the next step for the debaters is to find the evidence that will prove the issue true or false. Evidence can be in the form of either facts or opinions. *Facts* are actual occurrences or things that can be proved to exist. They may be made plain by means of comparisons, description, examples, narration, statistics, testimony, and visual aids. *Opinions* are interpretations of facts, and appraisals of the views of others. Only the opinions of experts on the particular subject should be given in a debate.

**Rebuttal.** After the issues have been determined and the evidence selected, the next step is to prepare to answer the arguments and evidence of the other team. The debaters must select the arguments and evidence of their opponents that they believe can be successfully attacked. Then they must prepare their own arguments and evidence that will be used in the attack.

**Several types of debates** are used in schools and colleges. In the *traditional* form of debate, there are two or three speakers on each side, each of whom makes both a *constructive* speech and a *rebuttal* or *reply* speech. With two speakers on each side, the speaking order might be:

**Constructive speeches** (eight minutes each)

1. First affirmative
2. First negative
3. Second affirmative
4. Second negative

**Rebuttal speeches** (four minutes each)

1. First negative
2. First affirmative
3. Second negative
4. Second affirmative

Another type of debate is the *cross-examination* form. Each constructive speaker is cross-examined by an opposing speaker. Then each side presents a rebuttal and a *summary*. Most teams consist of two speakers. However, a third speaker is sometimes used on each team to present the rebuttal and summary. With three speakers on each side, the order of speaking might be:

**Constructive speeches** (eight minutes) and **Cross-examinations** (four minutes)

1. First affirmative
2. Cross-examination by second negative
3. First negative
4. Cross-examination by first affirmative
5. Second affirmative
6. Cross-examination by first negative
7. Second negative
8. Cross-examination by second affirmative

**Rebuttal and summary speeches** (eight minutes)

1. Third negative
2. Third affirmative

**The decision.** If a decision is to be given in a debate, one or more judges listen to the speakers on both sides. Then each judge decides which team has presented the most convincing argument and votes for that team. The team with the most votes wins.

An alternative way of deciding a debate, often used on television or radio, is to ask the audience to vote on the issue. Sometimes a vote is taken before the debate and another one afterward to see if either argument has swayed opinion.

See also **Logic; Oratory; Public speaking.**

**Debenture bond.** See **Bond.**

**De Boissiere, Ralph A. C.** (1907- ) is a novelist, story-writer who was born of a wealthy French-Creole family in Trinidad. He was a member of the literary circle in the 1920's in Trinidad and a frequent contributor to the cultural journals *Trinidad* from 1929 to 1930 and *The Beacon* (1931).

In 1948 he emigrated to Australia where he worked in the motor industry. His first three novels were *Crown Jewel* (1952); *Rum and Coca Cola* (1956) and *No Saddles for Kangaroos* (1964).

His first novel covered the years 1935 to 1937 in Trinidad, ending with the uprising in the oilfields. The second covers the American occupation of Trinidad during the years 1940 to 1945. His third novel was based on his experiences in the early 1950's in Australia. His fourth novel is *Homeless in Paradise*. After a return visit to Trinidad in 1976 he was moved by the changes he found and the interest he received and wrote his fifth novel on Trinidad.

**Deborah** was a Biblical prophetess of Israel in the period of the Judges, the 1100's B.C. She was the wife of Lapidoth. She acted as an adviser to her people, and was a judge in their disputes. Deborah was admired for her wisdom, and she rose to a position of leadership among her people.

When she heard of the cruel treatment her people had received from the Canaanites, Deborah summoned Barak, the Israelite leader. Together they worked out a plan of action for the army of Israel. They hoped to defeat the Canaanite army under Sisera. They fought near Mount Tabor, on the plain of Esdraelon. A rainstorm aided Israel, turning the plain into mud and trapping the enemy chariots. Sisera fled on foot and was later murdered in his sleep. The victory was important in Israel's struggle with the Canaanites. One of the most notable victory odes of the Bible is the *Song of Deborah* in Judges 5.

**De Brazza's guenon.** See **Monkey** (picture: De Brazza's guenon).

**Debrecen** (pop. 211,823) is a commercial and industrial city in eastern Hungary. It serves as a market for nearby farming areas. For location, see **Hungary** (political map). Debrecen became a major centre of Protestantism in the 1500's and was called the *Calvinist Rome*. Lajos Kossuth proclaimed Hungarian independence there in 1849. In 1944, during World War II, Hungary's provisional government met in Debrecen.

**De Broglie, Louis Victor** (1892-1987), was a French physicist who won the 1929 Nobel Prize for physics for his theory of the wave nature of electrons. This theory became one of the foundations of *quantum mechanics*, a field of physics.



Since the early 1800's, physicists had believed that light consisted of waves of energy. They also thought that all matter was composed of tiny particles that combined in various ways to make up the material world. In 1900, Max Planck, a German physicist, showed that light behaves as if it consists of particles. He called these particles *quanta*. In 1924, De Broglie proposed that, under certain conditions, electrons have characteristics of both particles and waves, as do quanta of light. His theory was later verified by experiments.

De Broglie was born in Dieppe, France, and studied at the Sorbonne. He joined the faculty of the University of Paris in 1926.

See also **Quantum mechanics; Physics** (Quantum theory); Planck, Max K. E. L.

**Debs, Eugene Victor** (1855-1926), was a colourful and eloquent spokesman for the American labour movement and for socialism. He formed the American Railway Union (A.R.U.) in 1893 as an industrial union for all railway workers regardless of their craft. The A.R.U. ordered its members not to move Pullman cars in 1894, in support of a strike by the workers making Pullman cars. President Grover Cleveland used federal troops to break the strike, charging that it interfered with the mails. Debs went to prison for six months when he refused to comply with a federal court injunction. He came out of jail a confirmed socialist.

Debs made a speech condemning war during World War I. He was convicted under the Espionage Law in 1918 and went to prison the next year, on a 10-year sentence. President Warren G. Harding commuted his sentence in 1921.

Debs ran for the presidency as a socialist candidate five times. He was the nominee of the Social Democratic Party in 1900, and of the Socialist Party in 1904, 1908, 1912, and 1920. Debs ran his 1920 campaign while still in prison, and received nearly 1 million votes. He wrote *Walls and Bars*, a book dealing with prison problems.

Debs was born in Terre Haute, Indiana, and went to work in the railway shops at the age of 15. Later he became a locomotive fireman, and joined the Brotherhood of Locomotive Firemen (later the Brotherhood of Locomotive Firemen and Enginemen). He was national secretary and treasurer of the group from 1880 to 1893. Debs served in the Indiana legislature in 1885.

**Debt** is anything owed, especially a sum of money that one person owes to another. A person who owes a debt is called a *debtor*, and the one to whom it is owed is the *creditor*. If the debtor is unwilling or unable to pay the debt, the creditor may sue to recover the money. If the court finds that the debt is owed, and if the debtor fails to pay, the creditor may apply to the court for an *execution* of judgment. This gives the creditor the right to seize enough property of the debtor to pay the debt and the creditor's legal costs. But there are exceptions as to what may be seized.

In a special type of debt called *secured debt*, the debtor promises that, if the debt is not paid on time, the creditor may seize specified property from the debtor without applying to the court. If the value of the property is not enough to pay the entire debt, the creditor may then sue the debtor for the remaining amount. Most people purchase their homes through a type of secured debt called a *mortgage* (see **Mortgage**).

**Time limits on collection of debts.** The courts ordinarily state that debtors should pay their debts, even though the creditor does not demand payment. But if the creditor makes no effort to collect the money within a certain number of years, the debt becomes *barred* by a *statute of limitations* and can no longer be collected.

**Penalties for debts.** In ancient times, a debtor was handed over to the mercy of his creditors to become a slave. This was true in Greece and Rome, among the Hebrews, and among the Saxons in England. During feudal times, however, every man was first of all a soldier, and armies would have broken up if overlords jailed their men for the debts they owed.

As feudalism declined, and trade and industry rose, harsh treatment of debtors was revived. Prison terms were the usual punishment, and thus no money was recovered.

**Related articles in World Book include:**

Attachment	Collection	Garnishment	Moratorium
Bankruptcy	agency	Guarantee	National
Bond	Encumbrance	I.O.U.	debt

**Debt, National.** See **National debt**.

**Debussy, Claude** (1862-1918), was an important French composer. His revolutionary treatment of musical form and harmony helped to radically change the direction of music in the early 1900's.

Debussy felt closer to painters and poets than to other musicians, and he acknowledged the influence of literature and painting on his music. He sought a style of composition that was free from conventional musical forms, and he often used descriptive titles. He is regarded as the leader of impressionism in music.



Claude Debussy

Achille-Claude Debussy was born in St.-Germain-en-Laye. He entered the Paris Conservatory at the age of 10. Twelve years later, he won the 1884 Prix de Rome for his cantata *The Prodigal Son*. Other works of the late 1800's include the String Quartet in G minor (1893) and the three Nocturnes, the first two for orchestra (1900) and the third (1901) for female voices. The popular piano piece *Rêverie* (1890) is from this period, as is the *Suite bergamasque* (1890, revised 1905). Its third movement, "Clair de Lune," is often played separately. The orchestral *Prelude to "The Afternoon of a Faun"* (1894), based on a poem by Stéphane Mallarmé, pointed to Debussy's later works.

The turning point in Debussy's career came in 1902 with his opera *Pelléas and Mélisande*. Written as a series of short scenes that end without climaxes, the opera emphasizes natural speech as opposed to brilliant singing. In spite of the controversy caused by its unconventional style, the opera was an immediate success and began an extremely productive period for Debussy. His following compositions greatly expanded previous limits of musical structure and *tonality*, the relationship among various tones. This period lasted about 15 years and included the orchestral masterpieces *La Mer* (1905)



and *Images* (1913); the piano works *Estampes* (1903), *Masques* (1904), *L'isle joyeuse* (1904), two sets of *Images* (1905, 1907), and two books of *Préludes* (1910, 1913); and several sets of songs.

In 1909, Debussy suffered the first symptoms of cancer. He died of the disease nine years later. Probably because of his illness, he began working at a much slower pace. He started some operas and other large-scale projects but could not finish them.

From 1913 to 1917, Debussy abandoned impressionism for a more severe, abstract style. He returned to classicism with such works as the three chamber sonatas composed from 1915 to 1917. He also composed his most daring works. They include *Syrinx* for solo flute (1913), the 12 *Études* for piano (1915), and the ballet *Jeux* (1913). The ballet is sometimes considered Debussy's finest and most influential work.

See also **Classical music** (The 1900's).

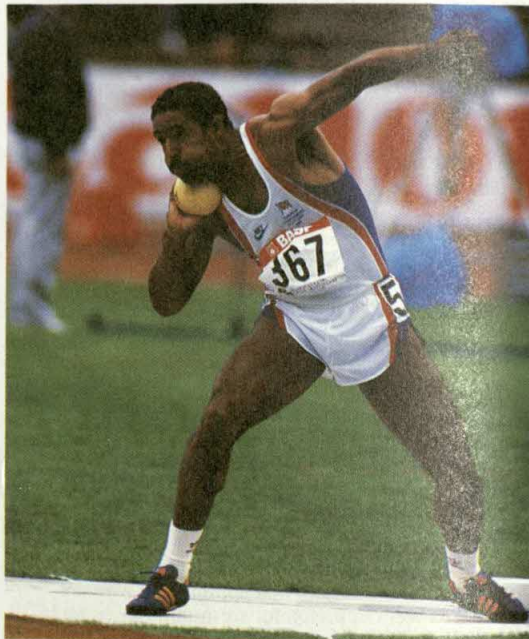
**Debye, Peter Joseph William** (1884-1966), a Dutch physicist and chemist, won the 1936 Nobel Prize for chemistry for studies of the physical properties of molecules. He was born in Maastricht, the Netherlands. He received a Ph.D. in physics from the University of Munich in 1908.

Debye was a pioneer in the field of chemical physics. He settled in the United States in 1940.

**Decaffeinated coffee.** See **Coffee** (Kinds of coffee).

**Decal** is the process of transferring printed designs, letters, or pictures from specially prepared paper onto various surfaces. The word *decalcomania* also describes this process. The print transferred is called a *decal* or *decal transfer*. Decals can be applied to such surfaces as glass, wood, plastic, and metal. They have many domestic and commercial uses. Manufacturers decorate dishes, furniture, and other products with decals. People use them to decorate toys, windows, and personal items.

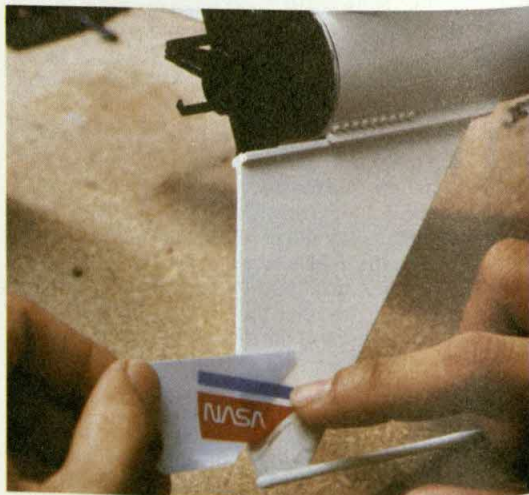
A decal is made of a thin film of oil paint and lacquer.



**Decathlon** is a ten-event athletics contest. Daley Thompson of the United Kingdom won the Olympic title in 1980 and 1984.

It is coated on one side with a special adhesive and placed on a paper backing. Some decals can be lifted off the backing and applied directly to an object. Others must be soaked in water to soften the adhesive. The decal is then slid from the backing onto the desired surface. The adhesive dries in about a minute and makes the decal stick.

Decals were developed in Germany in the 1800's.



**Decals** can be applied to such surfaces as glass, wood, plastics, and metal. Some decals have a sticky coating and can be applied directly to a surface, *left*. Other decals must first be soaked in water. The decal is then slid from the backing and pressed into place, *right*.



They were first used on dinnerware as a cheaper decorative process than hand painting.

**Decalogue.** See **Ten Commandments**.

**Decameron.** See **Boccaccio, Giovanni**.

**De Castella, Robert** (1957- ), won the marathon at the Commonwealth Games in 1982 and 1986. He finished fifth in the 1984 Olympic marathon. He was born in Melbourne, Australia. See also **Athletics**.

**Decathlon** is a two-day contest in 10 events to determine an all-round athletics champion. Athletes compete in the 100-metre dash, long jump, shot-put, high jump, and 400-metre run, in that order, on the first day. They try the 110-metre hurdles, discus throw, pole vault, javelin throw, and 1,500-metre run on the second day. The athletes compete against time and distance standards, instead of against each other. Up to 1,200 points can be won for each event. The athlete scoring the most total points wins the decathlon.

The decathlon became a part of the Olympic Games in 1912.

See also **Athletics** (The decathlon, heptathlon, and pentathlon; table: World athletics records).

**Decatur, Stephen** (1779-1820), was one of the most daring officers in the United States Navy during its early years. He is remembered for his toast: "Our country: In her intercourse with foreign nations may she always be right; but our country, right or wrong." Decatur enjoyed great popularity with his men and with the public.

Decatur was born in a log cabin in Sinepuxent, Maryland, on Jan. 5, 1779. He made his first long voyage at the age of 8, when he went to France on a ship commanded

by his father, a merchant captain. He became a midshipman in 1798 during the naval war with France, and rose to lieutenant in 1799. Given command of the *Enterprise* during the war with Tripoli, he captured an enemy vessel that was renamed the *Intrepid*. In this ship he led a picked band into Tripoli Harbour on the night of Feb. 16, 1804, and set fire to the frigate *Philadelphia*, once commanded by his father, which the Tripoli pirates had captured. Not a man was killed and only one was wounded. The English Admiral Horatio Nelson called this exploit "the most bold and daring act of the age." Because of it, Decatur won a sword from Congress and a captaincy when he was only 25.

Commanding a squadron of three ships in the War of 1812, he captured the British frigate *Macedonian* after a desperate struggle. He became a commodore in 1813, and took command of a squadron in New York Harbor. He attempted to run the British blockade early in 1815, but his flagship, the *President*, struck the bar at Sandy Hook and was damaged. He was forced into a fight against heavy odds. Wounded, he had to surrender. The British sent him to Bermuda as a prisoner of war, but he was soon released.

He next sailed against Algiers, Tunis, and Tripoli, where he forced the rulers to release United States ships and prisoners and to stop molesting U.S. vessels. On his return he became a navy commissioner. Suspended Commodore James Barron, at whose court-martial Decatur had presided, challenged him to a duel in 1820. Decatur was killed by the commodore near Bladensburg, Maryland. Barron had accused certain officers, headed by Decatur, of persecuting him.

**Decay** is the process by which dead animal or dead plant matter is broken down to simple compounds. These simpler products can then be used as food by living things, such as plants. Decay is an important process in the environment. The wastes that animals give off and the plants and animals that die are removed through this process. Decay is sometimes called *decomposition* or *putrefaction*.

The major part of the decay process is carried out by microbes, such as bacteria, moulds, and yeasts. Such microbes feed on and completely digest dead animal or plant matter, or the waste products of live animals. During decay, enzymes in the microbes break down *macromolecules* (large molecules). For example, the enzymes convert proteins to amino acids and complex carbohydrates to simple sugars. The microbes use these products to build the materials they need. They also use some of the products to get energy for growth and reproduction. As the microbes grow and multiply, the decay process speeds up.

Warmth and moisture help microbes grow and thus assist the decay process. Refrigeration or cooking kills microbes and slows decay. Certain chemicals also can destroy microbes and prevent decay.

**Related articles** in *World Book* include:

Antiseptic	Fermentation	Ptomaine poisoning
Bacteria	Food preservation	Teeth
Biochemistry	Mould	Yeast
Decomposition	Pasteur, Louis	

**Decay series.** See **Isotope** (Radioactive isotopes).

**Deccan.** See **India** (The Deccan; picture).

**Deceleration.** See **Motion** (Acceleration).



**Stephen Decatur** stands victoriously on the deck of a man-of-war after successfully forcing Algiers to sign a peace treaty.



**December** is the twelfth and last month of the year according to the Gregorian calendar, which is used in almost all the world today. It was the tenth month in the early Roman calendar and takes its name from the Latin word *decem*, which means *ten*. The Roman statesman Julius Caesar revised the calendar in 46 B.C. and made December the twelfth month. December once had 29 days, but Caesar added two more.

Winter begins in December in the northern half of the world. Some people call it "the frosty month." But winter does not begin until December 21 or 22, and most of December is usually warmer than later winter months. On the first day of winter, the sun reaches the solstice, when it appears to have gone farthest south. In the Northern Hemisphere, it is the shortest day of the year. But it is the longest day in the southern half of the world. The latter part of December has long been a holiday season. The Romans honoured Saturn, the god of agriculture, with a festival called *Saturnalia*. Today,

Christmas is the chief holiday of the month in many countries. Christians celebrate it as the birthday of Jesus Christ. The Druids of northern Europe used mistletoe in a December festival. Christians now use mistletoe at Christmas.

**Activities.** In the Northern Hemisphere, many birds have gone to warmer climates. But many animals are active. Mink, ermine, beavers, and foxes grow beautiful coats of fur. In the Southern Hemisphere, it is midsummer and many animals are in their breeding season.

**Special days.** People celebrate many holidays in December. They prepare for New Year's Eve parties on the last day of December. Some people in New England, U.S.A., observe December 21 as Forefathers' Day in honour of the landing of the Pilgrims at Plymouth on Dec. 21, 1620. People in several European countries celebrate December 6 as the Feast of Saint Nicholas. Many of them exchange gifts on that day.

After Christmas Day on December 25, some Christian

### Important December events

- 2 Battle of Austerlitz fought between France and the combined forces of Austria and Russia, 1805.
  - President James Monroe proclaimed the Monroe Doctrine in his message to Congress, 1823.
  - Scientists achieved the first controlled atomic chain reaction, in Chicago, U.S.A. 1942.
- 3 Eureka Stockade incident, a revolt by gold miners, in Australia, 1854.
  - Novelist Joseph Conrad born 1857.
  - Maria Callas, American-born opera singer, born 1923.
  - First human heart transplant performed by Christiaan Barnard, South African surgeon, 1967.
  - Bhopal pesticide plant disaster killed more than 2,000 people in India, 1984.
- 4 Thomas Carlyle, Scottish author, born 1795.
- 5 American film producer Walt Disney born 1901.
  - Amendment 21 to the United States Constitution, repealing prohibition, proclaimed, 1933.
- 6 Europeans celebrate the Feast of St. Nicholas.
  - Columbus discovered Hispaniola, 1492.
  - Proclamation of Irish Free State, 1922.
  - War broke out between India and Pakistan, 1971.
- 7 Japanese forces attacked the U.S. naval base at Pearl Harbor in Hawaii in World War II, 1941.
- 8 Horace, Roman poet, born 65 B.C.
  - Eli Whitney, inventor of cotton gin, born 1765.
  - Jan Sibelius, Finnish composer, born 1865.
  - First weekly air mail service between England and Australia, 1934.
  - Chinese Nationalists fled the mainland, moving their capital to Formosa (today Taiwan), 1949.
  - John Lennon, English pop musician, shot and killed in New York City, 1980.
- 9 John Milton, English poet, born 1608.
  - Joel Chandler Harris, American author of the "Uncle Remus" stories, born 1848.
  - Bob Hawke, Australian prime minister, born 1929.
- 10 British Royal Academy founded, 1768.
  - Emily Dickinson, American poet, born 1830.
  - Spain ceded Philippines to the United States, 1898.
  - Ross and Keith Smith, Australian aviators, completed first flight from England to Australia, 1919.
- 11 Hector Berlioz, French composer, born 1803.
  - Robert Koch, German bacteriologist, born 1843.
  - Edward VIII of Great Britain abdicated, 1936.
  - Last Apollo moon landing, by Apollo 17, 1972.
- 12 John Jay, American diplomat, born 1745.
  - Gustave Flaubert, French novelist, born 1821.
  - Guglielmo Marconi received the first radio signal sent across the Atlantic Ocean, 1901.
- 13 The Council of Trent opened, 1545.
  - Sir Francis Drake left England to sail around the world, attacking Spanish possessions, 1577.
- 14 Tycho Brahe, Danish astronomer, born 1546.
  - George Washington died at Mt. Vernon, 1799.
  - Roald Amundsen, Norwegian explorer, reached the South Pole, 1911.
- 15 Maxwell Anderson, American playwright, born 1888.
- 16 Oliver Cromwell became Lord Protector of the Commonwealth, and ruler of England, 1653.
  - Composer Ludwig van Beethoven born 1770.
  - Boston Tea Party, 1773.
  - Novelist Jane Austen born 1775.
  - Actor-playwright Sir Noel Coward born 1899.
  - East Pakistan (today Bangladesh) achieved independence from West Pakistan (today Pakistan), 1971.



Dec. birthstone—turquoise



Dec. 7—Japanese attack Pearl Harbor



Dec. 12—Marconi's transatlantic radio signal



Dec. 14—Roald Amundsen reaches South Pole



churches observe the Feast of Saint Stephen on December 26, the Feast of Saint John the Evangelist on December 27, and Holy Innocents' Day on December 28.

**Popular beliefs.** A beautiful Bible story tells how the star of Bethlehem guided the wise men to the place where they found the Christ child. The star at the top of a Christmas tree symbolizes this star.

**Symbols.** Holly, narcissus, and poinsettia are special December flowers. The turquoise and the zircon are December birthstones.

### Quotations

'Twas the night before Christmas, when all through the house

Not a creature was stirring, not even a mouse;  
The stockings were hung by the chimney with care,  
In hopes that St. Nicholas soon would be there;  
The children were nestled all snug in their beds,  
While visions of sugar-plums danced in their heads.

Attributed to *Clement Clarke Moore*

Heap on more wood! The wind is chill;  
But let it whistle as it will,  
We'll keep our Christmas merry still.

*Sir Walter Scott*

The sun that brief December day  
Rose cheerless over hills of grey,  
And, darkly circled, gave at noon  
A sadder sight than waning moon.

*John Greenleaf Whittier*

I heard the bells on Christmas Day  
Their old, familiar carols play,  
And wild and sweet  
The words repeat  
Of peace on earth, good will to men.

*Henry Wadsworth Longfellow*

### Related articles in *World Book* include:

Calendar	Nicholas, Saint	Solstice
Christmas	Santa Claus	Turquoise
Holly		

## Important December events

- 17 Sir Humphry Davy, English chemist, born 1778.
  - John Greenleaf Whittier, American poet, born 1807.
  - William Lyon Mackenzie King, three times prime minister of Canada, born 1874.
  - Orville Wright made first heavier-than-air flight at Kitty Hawk, North Carolina, U.S.A., 1903.
  - Willard Libby, American chemist, born 1908.
- 18 Charles Wesley, English clergyman and author of many hymns, born 1707.
  - Amendment 13 to the U.S. Constitution, ending slavery, proclaimed, 1865.
  - Christopher Fry, British playwright, born 1907.
- 19 Washington's army camped for the winter at Valley Forge, Pennsylvania, in the American Revolution, 1777.
- 20 The United States took over Louisiana, 1803.
  - Sir Robert Menzies, Australian prime minister, born 1894.
- 21 The Pilgrims landed at Plymouth, Massachusetts, 1620.
  - French playwright Jean Baptiste Racine born 1639.
  - Benjamin Disraeli, twice prime minister of Great Britain, born 1804.
  - Joseph Stalin, Soviet dictator, born 1879.
  - Launch of Apollo 8, first manned spacecraft to leave earth orbit and fly around the moon, 1968.
- 22 James Oglethorpe, founder of Georgia settlement in America, born 1696.
  - Opera composer Giacomo Puccini born 1858.
- 23 Richard Arkwright, British inventor, born 1732.
- 24 "Kit" Carson, American frontier scout, born 1809.
  - United States and Great Britain signed the Treaty of Ghent, ending the War of 1812, 1814.
  - Matthew Arnold, British writer, born, 1822.
  - Women in Switzerland got the vote, 1971.
- 25 Christmas, celebrated by Christians as the birthday of Jesus Christ.
  - Isaac Newton, English mathematician who discovered laws of gravitation, born 1642.
  - Clara Barton, "Angel of the Battlefield" and founder of the American Red Cross, born 1821.
- 26 Charles Babbage, British scientist known as "father of the computer," born 1792.
  - Mao Zedong, Chinese Communist leader, born 1893.
- 27 Johannes Kepler, German astronomer, born 1571.
  - Louis Pasteur, French chemist, born 1822.
  - Sir Mackenzie Bowell, prime minister of Canada from 1894 to 1896, born 1823.
  - Singapore became a republic, 1965.
  - Soviet troops invaded Afghanistan to crush a revolt against that country's Communist government, 1979.
- 28 U.S. state of Iowa admitted to the Union, 1846.
- 29 Saint Thomas à Beckett was murdered at Canterbury Cathedral, England, 1170.
  - Woodrow Wilson, 28th President of the United States, born at Staunton, Virginia, U.S.A., 1856.
  - William Gladstone, four-times prime minister of Great Britain, born 1809.
- 30 Rudyard Kipling, British writer, born 1865.
  - Rizal Day in the Philippines, honouring patriot José Rizal, executed by the Spanish, 1896.
  - Sun Yat-sen became president of the Chinese republic, 1911.
- 31 Andreas Vesalius, the first anatomist to describe the human body completely, born 1514.
  - Henri Matisse, French painter, born 1869.
  - Solidarity trade union formed to challenge Communist rule in Poland, 1980.



Dec. 16—Boston Tea Party



Dec. 17—first flight by Orville Wright



Dec. 21—Pilgrims' arrival in America



Dec. 25—Isaac Newton born



**Decembrist Uprising.** See Nicholas I; Russia.

**Decemvirs.** See Twelve Tables, Laws of the.

**Decibel** is a unit used in comparing sound pressure, voltage, power, and some other related acoustic and electrical quantities. Its symbol is dB. A decibel equals one-tenth of a *bel*, a unit which was named after the Scottish-born inventor and scientist Alexander Graham Bell.

In acoustics, the decibel is frequently used to compare the intensity or pressure of sound with fixed reference levels. For measuring intensity, the most common reference level is  $10^{-12}$  watts per square metre. This level equals 0 decibels. The common reference point for sound pressure level is  $2 \times 10^{-5}$  pascals (see Pascal). Thus, a sound pressure level of 60 decibels means that the sound pressure is 60 decibels above the reference level.

Sound at a level of 10 decibels is barely audible to the normal human ear. The level of sound pressure in a quiet room may be about 40 decibels, but a level of 70 decibels would be considered noisy. Sound at the 70-decibel level transmits 1,000 times as much energy as sound at 40 decibels.

See also Sound (Measuring sound).

**Deciduous tree** is the name for any tree that loses its leaves at a certain time each year and later grows new leaves. In northern temperate regions, most deciduous trees lose their leaves in the autumn. The twigs and branches stay bare all winter. The following spring the trees grow a new set of green leaves. Before the leaves die, some of the food material they contain is drawn back into the twigs and branches. There it is stored and used the following spring. Deciduous trees usually have broad leaves. Such trees include ash, beech, birch, maple, and oak. Larch is a common deciduous tree that has needlelike leaves.

Dried leaves continue to hang on the branches of some deciduous trees until the new leaves come out. In warmer climates, deciduous trees grow new leaves earlier in the spring and retain their leaves for a longer period of time.

Scientists think that losing the leaves helps some trees to conserve water in the winter. Water normally passes into the air from tree leaves by a process called *transpiration*.

See also Tree (Broadleaf trees).

**Decimal numeral system.** See Decimal system.

**Decimal system** is a way of writing numbers. Any number, from huge quantities to tiny fractions, can be written in the decimal system using only the ten basic symbols 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. The value of any of these symbols depends on the place it occupies in the number. The symbol 2, for example, has totally different values in the numbers 832 and 238, because the 2 is in different places in each of the numbers. Because the value of a symbol depends on where it is placed within a number, the decimal system is known as a *place-value system*.

The word *decimal* comes from *decem*, the Latin word for *ten*. The decimal system received its name because it is a *base-ten system*. The value of each place is ten times greater than the value of the place just to its right. Thus, the symbols on the left of a number have larger values than symbols farther to the right. For example, the sym-

bol 2 in 238 is worth much more than the symbol 2 in 832, because the 2 in 238 is farther to the left than is the 2 in 832.

The decimal system is also called the *Hindu-Arabic system*. It was developed by Hindu mathematicians in India more than 2,000 years ago. Arabs learned this system after conquering parts of India in the A.D. 700's. They spread knowledge of the system throughout their empire, including the Middle East, northern Africa, and Spain.

### The decimal system and number words

In the English language, special number words are used to name the value of each place in the decimal system except the *ones place* (the place farthest to the right). The letters "ty" at the end of the words for numbers in the second place (just left of the ones place) indicate that these mean a number of tens. For example, *sixty* means *six tens* and *ninety* means *nine tens*. The word *hundred* is used to show the size of the third place, and *thousand* for the fourth place. Then there are only new words for every third place to the left.

A comma is placed after each third place to make it easier to read a decimal system number. The words *ten* and *hundred* are used with *thousand* and the other special words to name all the places between the special places. Each group of three numbers between commas is read as if it had only three places, and then the name of its group is added. For example, the number 5,246,380,901,483 can be read as "five trillion, two hundred and forty-six billion, three hundred and eighty million, nine hundred and one thousand, four hundred and eighty-three."

Large numbers in the decimal system can easily be expressed using an *exponent*, also called an index or power. An exponent is a symbol written to the right and above a number, and it tells how many times a number is multiplied by itself. For example, in the figure  $10^6$ , the exponent 6 indicates that six tens are multiplied together. The figure  $10^6$  is read as *ten to the sixth power*, or *ten to the power six*, or *ten to the six*. Because multiplying by ten moves a number written in the decimal

### Some large decimal system numbers

Number word	How many	Written in the decimal system	Written in exponents
Thousand	one thousand	1,000	$10^3$
Million	one thousand thousands	1,000,000	$10^6$
Billion	one thousand millions	1,000,000,000	$10^9$
Trillion	one thousand billions	1,000,000,000,000	$10^{12}$
Quadrillion	one thousand trillions	1,000,000,000,000,000	$10^{15}$

The names for the next thousands are quintillion, sextillion, septillion, octillion, nonillion, decillion, undecillion, duodecillion, tredecillion, quattuordecillion, quindecillion, sexdecillion, septendecillion, octodecillion, novemdecillion, and vigintillion. In Australia and Great Britain, the word *billion* refers in some cases to a million millions rather than to a thousand millions. *Trillion* refers to a million billions, and so on. However, in this encyclopedia, the words used for large numbers have the meanings given in the table above.



system over one place to the left, the exponent for ten also tells how many zeros to write when that number is written in the decimal system. Thus,  $10^6$  is written as a 1 followed by six zeros—1,000,000.

### Decimals less than one

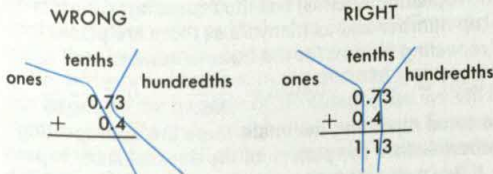
In the decimal system, as the places go to the left of the ones place, each place gets ten times larger than the last. But the places can also go to the right of the ones place. As places go to the right, the values of those places get smaller. In the first place to the right, the one is divided into ten equal parts, called *tenths*. In the second place to the right, each tenth is itself divided into ten parts. As a result, in this place, the one has been divided into ten times ten—or one hundred—small parts. Each of these small parts, which are called *hundredths*, gets divided into ten smaller parts in the third place, and so on.

The names for the places to the right are like those for the places to the left, except that the letters "th" are added to the name for each place. The letters "th" show that the one is divided into that many small parts. The names for the places to the right sound as if the values are getting bigger, but the "th" at the end of the words shows that the values are really getting smaller. It takes only ten tenths to make one, but it takes a million millionths to equal one.

A full stop or point, called the *decimal point*, is written between the ones place and the first small decimal place to show when a decimal system number includes the small places to the right of the ones place. When a decimal system number does not include any places to the right of the ones place, a point does not have to be written. The point is usually read as "point" to show that the smaller places are starting. For example, 345.678 is read as "three hundred and forty-five point six seven eight." The places in the decimal system are *symmetric* (balanced) around the ones place, not around the decimal point.

hundreds tens ones . tenths hundredths

**Addition and subtraction** of decimals smaller than one are done in the same way as addition and subtraction of whole numbers. Only numbers in the same places can be added or subtracted. One number is written beneath the other number so that matching places line up—that is, tenths are beneath tenths, hundredths beneath hundredths, and so on.



To add or subtract numbers with decimals less than one, write one number beneath the other number so that the decimal point of the bottom number is right beneath the decimal point of the top number. It does not matter if one number has numerals sticking out to the right or left of the other number. You can put in zeros in any places that are missing numerals. Then add or sub-

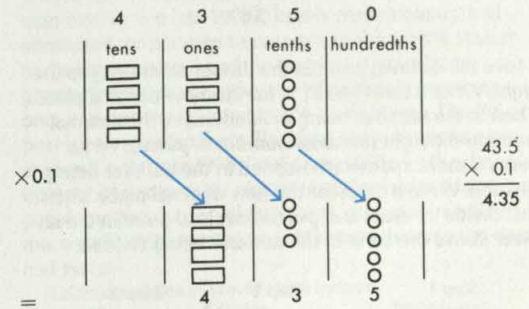
tract the numerals that are just above and below each other.

$7 - 2.61$	$0.356 + 27.9$	$548 - 6.08$
$\begin{array}{r} 7.00 \\ - 2.61 \\ \hline 4.39 \end{array}$	$\begin{array}{r} 0.356 \\ + 27.9 \\ \hline 28.256 \end{array}$	$\begin{array}{r} 548. \\ - 6.08 \\ \hline 541.92 \end{array}$

**Multiplication** of one whole number by another gives a number larger than the original number. But multiplication of a number by a decimal less than one gives a number which is *smaller* than the original number.

$2 \times 3$  means two groups of three  
 $0.1 \times 3$  means 0.1 group of three,  
 or one-tenth of three, which  
 is just part of three

The multiplication shift rule for multiplying a number by 0.1 (one-tenth) is that each digit in that number moves one place to the right—that is, it moves one place smaller.



In this example, the number 43.50 consists of four tens, three ones, and five tenths. When multiplied by 0.1, each of the five tenths becomes a hundredth, because a hundredth is a tenth of a tenth. Each of the three ones becomes a tenth, because a tenth is one-tenth of a one. One-tenth of ten ones is one, so each of the 4 tens becomes a one. So the 43.50 becomes 4.35. The principle is the same for multiplying pounds or dollars.

The multiplication shift rule for multiplying a number by 0.01 (one-hundredth) states that each digit in the number moves two places to the right. Each digit in a number multiplied by 0.001 (one-thousandth) moves three places to the right, and so on. In general, when a number is multiplied by any decimal smaller than one, the number moves as many places to the right as there are places smaller than one. Therefore, the rule for multiplying any number by a decimal number is: Multiply as usual. Then add the number of decimal places in the top number to the number of places in the bottom number and put that many decimal places in the answer.

$\begin{array}{r} 27.5 \\ \times 0.03 \\ \hline 0.825 \end{array}$	one place two places three places
--	---



## 70 Decimal system

In this example, there is one decimal place in the top number. Multiplying this number by 0.03 will move the number over two more places to the right. So there will be 1 + 2 decimal places in the answer.

**Division** of a number by a decimal number smaller than one means finding out how many of those small decimal parts there are in that number. In problems involving the division of a whole number by a decimal smaller than one, the answer is always *larger* than the number being divided.

$6 \div 2$  means "How many twos in six?"

$6 \div 0.1$  means "How many tenths in six?"

Asking how many tenths there are in six is similar to "How many 10-cent coins are in six dollars?" There are ten 10-cent coins in one dollar, so there are  $6 \times \text{ten}$  (60) 10-cent coins in six dollars. Therefore,  $6 \div 0.1 = 60$ .

The division shift rule for tenths is just the opposite of the multiplication shift rule for tenths. Each place in the number being divided shifts one place to the *left* (gets one place larger). When a number is divided by 0.01 (one-hundredth), each place moves two places to the left, and so on.

To divide by a number with places smaller than one, write the problem in long division form.

$$1.08 \overline{)75.6}$$

Move the decimal point in the divisor all the way to the right. Write a caret mark (^) for this new decimal place. Then in the number being divided, move the decimal point to the right *the same number of places*. Write zeros if more spaces are needed in the number being divided. Write a caret for the new decimal place. Then just divide as usual and put the decimal point in the answer above the caret in the number being divided.

Step 1	Step 2	Step 3
$1.08 \overline{)75.6}$	$1.08 \overline{)75.60}$	$1.08 \overline{)75.60}$
		$\begin{array}{r} 70. \\ 75.6 \\ \hline 00 \end{array}$

This rule works because you are just multiplying the problem by 1, which will not change the answer:

$$\frac{75.6}{1.08} = \frac{75.6}{1.08} \times 1 = \frac{75.6}{1.08} \times \frac{100}{100} = \frac{7560}{108} = 70$$

### Decimals and fractions

In mathematics, any number that can be written in the form of a fraction—that is, as one number divided by another—is called a *rational number*. All rational numbers can be written in the decimal system. When rational numbers are changed to the decimal form, the result is either a *repeating decimal* or a *terminating decimal*. A repeating decimal is one that goes on repeating the same number or series of numbers, such as 0.333... and 0.14851485... The dots at the end show that the same pattern repeats over and over. This repetition may also be shown by writing a bar line above the repeating pattern:  $0.\overline{3}$  and  $0.1485\overline{1485}$ . A terminating decimal is one in which the division at some point comes out even and so the decimal number stops.

Any repeating or terminating decimal can be written as a rational number—that is, in fraction form. But some

decimal numbers, called *irrational numbers*, never repeat or end and cannot be written in rational form. Two examples of irrational numbers are  $\sqrt{2}$  and pi ( $\pi$ ). The symbol  $\sqrt{2}$  represents the square root of two. This is the number which when multiplied by itself gives two. It is between 1.4142135 and 1.4142136. Pi is the number you get when you divide the *circumference* (the distance around) of any circle by its *diameter* (the distance across it through its centre). The value of pi has been calculated to thousands of decimal places by computers. It is between 3.1415926 and 3.1415927, which is accurate enough for most purposes. See Circle; Pi.

**Changing fractions to decimals.** To change a number from the fraction form to the decimal form, just carry out the division that is implied in the fraction. Divide the *numerator* (top number) by the *denominator* (bottom number). This division will always give either a terminating decimal or a repeating decimal, because the remainder will eventually be 0 or will repeat an earlier remainder. A repeating decimal can be rounded off to any place.

Terminating decimal	Repeating decimal
$\frac{3}{5} \rightarrow \frac{0.6}{5 \overline{)3.0}}$	$\frac{2}{3} = \frac{0.666...}{3 \overline{)2.000}}$
$\frac{3}{5} = 0.6$	$\begin{array}{r} 18 \\ 20 \\ \hline 18 \\ 20 \\ \hline 18 \\ 2 \end{array}$

**Changing decimals to fractions.** To change a decimal to a regular fraction, write the number without any decimal point as the top of the regular fraction. For the bottom of the regular fraction, write the numeral 1 followed by as many zeros as there are places to the right of the decimal point in the decimal. This bottom number is the value of the last place in the decimal.

$$0.28 = \frac{28}{100} \qquad 0.005 = \frac{5}{1000}$$

$\uparrow$	$\uparrow$
hundredths place	thousandths place
two places	three places
$\rightarrow$	$\rightarrow$
two zeros	three zeros

The exact procedure for changing a repeating decimal to a fraction varies with the form of the repeating decimal. If the repeating decimal starts in the tenths place and has no whole numbers in it, the fraction form of the repeating decimal has the repeating pattern as the top number and as many 9's as there are places in the repeating pattern for the bottom number.

$$0.58\overline{1} = \frac{581}{999} \qquad 0.4628\overline{8} = \frac{4628}{9999} \qquad 0.14\overline{14} = \frac{14}{99}$$

In some repeating decimals, there are nonrepeating numbers before the pattern of the decimal starts repeating. If these nonrepeating numbers are whole numbers, the top number for the new fraction is made by writing the repeating decimal up to the first repeat of the pattern and subtracting from this the whole number. The bottom number is as many 9's as there are in the repeating pattern.

$$25.63\overline{9} = \frac{25639 - 25}{999} = \frac{25614}{999}$$



In some repeating decimals, the nonrepeating numbers are to the right of the decimal point. In such cases, the top number is made by writing the nonrepeating part followed by one repeat of the pattern. The nonrepeating part is then subtracted from this number. The bottom number is made by writing as many 9's as there are places in the repeating pattern, followed by as many 0's as there are nonrepeating places to the right of the decimal point.

$$0.74\bar{5} = \frac{745 - 74}{900} = \frac{671}{900}$$

$$5.169\bar{3} = \frac{51693 - 51}{9990} = \frac{51642}{9990}$$

### History

**Invention of the decimal system.** The decimal system was invented in India, but no one knows exactly when or where. As early as 250 B.C., a base-ten number system was written in Brahmi, a script used for writing the Sanskrit language. The Hindu-Arabic numerals 1, 2, 3, 4, 5, 6, 7, 8, and 9 are based on the Brahmi symbols for the numbers one to nine. However, the Brahmi number system also used special symbols for ten, twenty, thirty, forty, fifty, sixty, seventy, eighty, ninety, one hundred, and one thousand.

By A.D. 595, all the extra symbols had been dropped from the system. All numbers were written by using just the symbols for one to nine. The place in which a symbol was written told its value. However, there was a problem with this place-value system. If a given place was empty, some new symbol was needed to hold that place empty so that all the other symbols would stay in their correct places. The first record of the use of such a new symbol in the Brahmi system is from A.D. 876. This symbol is what we now call zero. The Maya of Central America, who also invented a place-value system, used a zero before A.D. 300 (see **Zero**).

**Spread of the decimal system.** During the 700's, Arabs conquered parts of India. They learned the decimal system there, and during the next 300 years, spread it throughout their empire—through the Middle East to northern Africa, and into Spain.

The system was introduced into Europe by several people, including Pope Sylvester II about 1000 and Leonardo Fibonacci, an Italian mathematician, in 1202. At that time, however, new learning in books did not reach large numbers of people, chiefly because books were copied by hand and were therefore scarce. But soon after the printing press was invented in the mid-1400's, several arithmetic books that explained the use of the decimal system were published in England, France, Germany, the Netherlands, and other countries.

The widespread interest in the decimal system was due largely to the number of advantages the system had over Roman numerals, which most people in Europe used at the time (see **Roman numerals**). Calculations are difficult with Roman numerals, so people used little round pieces of metal as counters. They performed their calculations with such devices as calculating boards or calculating cloths that had vertical columns drawn on them to make places for the counters. But because of the place-value nature of the decimal system, calculations could be performed with decimal numbers by using just a pen and paper. Counters and a counting

board or cloth were no longer necessary. It also takes less space to write a number in the decimal system. Larger and larger numbers can be written in the decimal system without inventing any new symbols. Another advantage is that numbers smaller than one can be written in the decimal system, and calculations can be performed with these numbers.

**Use of decimals smaller than one.** The first books written in Europe about the decimal system did not say anything about decimals smaller than one. Such decimals were used in China many centuries before they were introduced into Europe and were used by Arab astronomers by at least the early 1400's. Some European mathematicians and astronomers had also known about decimals smaller than one, but the first evidence of their use by merchants and ordinary people appeared in a Flemish pamphlet, published in the Netherlands in 1585. John Napier, a Scottish baron who studied mathematics, invented shortly before his death in 1617 an easier way to write decimals smaller than one, and we still use his method today.

In the late 1700's, France adopted a metric system of weights and measures and a new money system. Both were based on the decimal system (see **Metric system**). They enabled many more people to use decimals less than one. By the late 1900's, nearly every country had converted, or planned to convert, to the metric system of measurement. Use of the metric system placed greater importance on the use of decimals less than one, and decreased importance on fractions. The importance of decimals smaller than one was further increased in the late 1970's and early 1980's by the development of inexpensive electronic calculators. Many problems previously solved using fractions are solved more easily with electronic calculators that use the decimal system.

**Related articles in *World Book* include:**

Abacus	Fraction	Percentage
Arabic numerals	Metric system	Rational number
Arithmetic	Numeration systems	

**Decimetre.** See **Metric System** (Using the metric system).

**Decipher.** See **Codes and ciphers**.

**Declaration of Human Rights.** See **Human Rights, Universal Declaration of**.

**Declaration of Independence** is the historic document in which the British colonies in America declared their freedom from British rule. The Second Continental Congress, a meeting of delegates from the colonies, adopted the Declaration on July 4, 1776. This date is celebrated as the birthday of the United States.

The Declaration of Independence ranks as one of the greatest documents in human history. It eloquently expressed the colonies' reasons for proclaiming their freedom from British rule. The document blamed the British government for a number of abuses. But it also stated that all people have certain rights, including the right to change or overthrow any government that denies them their rights. The declaration contains two famous paragraphs:

"We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.



"That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed."

The ideas expressed in the Declaration have long inspired freedom-loving people throughout the world.

**Events leading to the Declaration.** Friction between the American Colonies and Britain had been building for more than 10 years before the Declaration was adopted. The colonists protested against "taxation without representation", but found the British government unwilling to loosen its control over the colonies.

In 1774, delegates from all the colonies except Georgia met in Philadelphia at the First Continental Congress. To back their claim for more self-government, the delegates adopted an agreement that bound the colonies not to trade with Britain or to use British goods.

But Britain held to its policies, and the Second Continental Congress was called. The delegates met in Philadelphia's State House (now Independence Hall) on May 10, 1775. By that time, the Revolutionary War in America had already begun, with battles between Massachusetts colonists and British troops.

In 1776, the independence movement grew rapidly. The English writer Thomas Paine spurred the movement with his electrifying pamphlet *Common Sense*. This work presented brilliant arguments for the freedom of the American Colonies. More and more Americans came to agree with the patriot Samuel Adams, who asked, "Is not America already independent? Why not then declare it?"

On June 7, 1776, Richard Henry Lee of Virginia introduced the resolution in Congress "That these United Colonies are, and of right ought to be, free and independent States. . . ." On June 10, Congress voted to draft a declaration of independence for the delegates to consider in case they adopted Lee's resolution. Thomas Jefferson was asked to draft the declaration.

On July 2, Congress approved Lee's resolution. On July 4, Congress adopted the final draft of the Declaration of Independence.

The Declaration, signed by John Hancock as president of Congress, was printed and read to a large crowd in

the grounds of the State House on July 8. Members of Congress signed a parchment copy of the Declaration on August 2.

**The importance of the Declaration** was that it magnificently expressed the thoughts of the American patriots. It reflected ideas on social and political justice held by various philosophers of the time, especially the English philosopher John Locke. While the eloquent language of the document stirred the hearts of the American people, it also aroused people in Europe to make their governments more democratic. Over the years, many newly emerging nations have looked to the Declaration's expressive language in giving their reasons for seeking freedom from foreign control.

The original parchment copy of the Declaration is housed in the United States National Archives Building in Washington, D.C. It is displayed with two other historic American documents—the United States Constitution and the Bill of Rights.

See also **Continental Congress; Independence Day; Locke, John; United States, History of the; Paine, Thomas; American Revolution.**

**Declaration of Rights.** See **Bill of Rights; Continental Congress; Human Rights, Universal Declaration of; Rights of Man, Declaration of the.**

**Declension** is a listing of the different case forms of a noun or pronoun. Some languages, such as Latin, Greek, and Russian, have complicated case systems. They have many different forms for each noun or pronoun, varying with the way the words are used in the construction of sentences.

In English, the declension of nouns is simple. English nouns have only two case forms: a *common* case, used for both subject and object, and a *possessive* case. For example, in "The scoutmaster instructed the boy," *scoutmaster* is the subject and *boy* is the object, but the common case is used for both. The possessive form is marked by the inflection *'s*, as in the sentence "The *scoutmaster's* instructions greatly helped the *boy's* progress."

The pronouns *I, he, she, we, they, and who* show three case forms—subjective (sometimes called nominative), objective, and possessive. The following declension shows the differences among the forms. It also includes a variation in the possessive form in four of the pronouns:

Subjective	I	he	she	we	they	who
Objective	me	him	her	us	them	whom
Possessive	my	his	her	our	their	whose
Variation	mine		hers	ours	theirs	

The pronouns *it* and *you* show only two case forms, common and possessive.

See also **Case; Pronoun; Inflection.**

**Declination.** See **Compass (Variation); Astronomy (table; picture).**

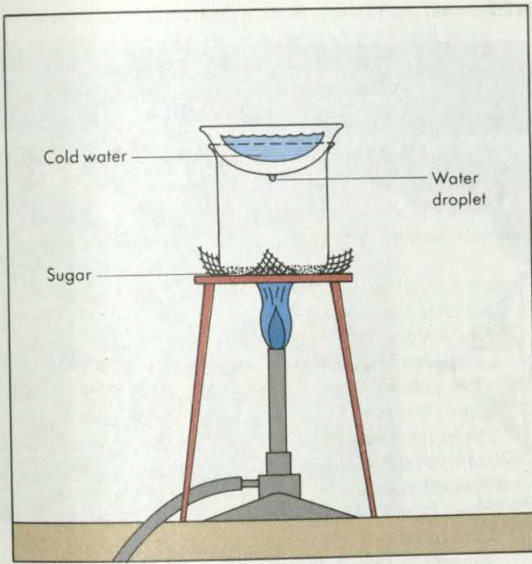
**Decoding.** See **Codes and ciphers.**

**Decomposition**, in chemistry, is the breaking down of a substance into simpler products, or into the elements of which it is composed. Decomposition may be brought about in several ways. Heat decomposes red mercuric oxide into its elements of oxygen and bright metallic mercury. Heat breaks down limestone to form lime and carbon dioxide. Heat also decomposes many



The Continental Congress adopted the Declaration of Independence at Philadelphia on July 4, 1776.





**In decomposition**, a substance is broken down into simpler products. Table sugar decomposes into carbon and water when heated. The carbon stays in the beaker. The water forms droplets at the bottom of an evaporating dish filled with cold water.

organic compounds. An electric current decomposes water into its elements hydrogen and oxygen. Many substances are decomposed by chemical action. Sodium carbonate is used to decompose silicate rocks. Starch is broken down into a simple sugar, called *glucose*, by the action of a boiling, dilute acid. Decomposition may also be caused by the action of light, bacteria, or enzymes. The enzymes in yeast ferment sugar into simple products.

A distinction is sometimes made between decomposition caused by people, as in chemistry, and decomposition that occurs in nature. For example, animal and vegetable matter, when attacked by certain microorganisms, are said to *decompose*, or decay. Such natural decay is also called *putrefaction*. The decomposition of animals and plants is important in geology. For example, coal and petroleum are formed from marsh plants that became buried in swamps and decayed.

See also Decay.

**Decompression sickness.** See Bends.

**Decoration, interior.** See Interior decoration.

**Decorations, medals, and orders** are honours that are awarded to people for bravery or merit. These honours are generally given by a monarch or head of state. People granted such honours receive a badge that may be worn or displayed. In most cases, the badges are suspended from a ribbon. The designs and colours of the ribbon usually symbolize the national colours of a country. They also may symbolize such characteristics as virtue or bravery.

**Decorations** are mostly in the shape of a cross or star, suspended from a ribbon. They are usually given in wartime for a single act of outstanding gallantry. In the armed forces, decorations are generally more important than medals. The Victoria Cross of the United Kingdom and Commonwealth is an example of a decoration.

**Medals** are usually round and bear the likeness of a head of state or other symbol surrounded by an inscription. Most medals are made of gold, silver, or bronze. Medals generally hang from a ribbon. Medals are usually presented for participation in a campaign, long service, or good conduct.

**Orders** have a variety of shapes, but stars and crosses are used most frequently. The most common type of cross is the *Maltese cross*. Its four arms have V-shaped ends. Traditionally, orders have been exclusive societies with a limited membership determined by the head of state. In countries where orders exist, membership in an order is generally considered the highest degree of honour.

### The Commonwealth

Most United Kingdom decorations, medals, and orders are also awarded, in the Queen's name, to people of some of the other countries of the Commonwealth.

**Honours lists** are issued twice a year. The New Year's Honours list is published on or about December 31, and the Birthday Honours List on the Queen's official birthday, early in June. A third list, the Dissolution Honours List, is published when Parliament is dissolved before a British general election. Four orders are the personal awards of the Queen. They are the Order of the Garter, the Order of the Thistle, the Order of Merit, and the Royal Victorian Order. Awards for bravery are published separately.

**Order of precedence.** There is a strict order of precedence in which Commonwealth orders, decorations, and medals should be worn. First come the Victoria Cross and the George Cross, the highest awards for bravery. Next come the *Orders*—the Garter, the Thistle, the Bath, Merit, St. Michael and St. George, the Royal Victorian, and the British Empire, and the Order of the Companions of Honour and the Distinguished Service Order. Four Orders—the Bath, St. Michael and St. George, the Royal Victorian, and the British Empire—have several classes each. A higher class of a lower order would rank before a lower class of a higher order. For example, a Knight Grand Cross of the Order of the British Empire would rank before a Companion of the Order of the Bath.

**Decorations** ranking next are the Royal Red Cross, the Distinguished Service Cross, the Military Cross, the Distinguished Flying Cross, and the Air Force Cross.

**Medals for gallantry and distinguished service** total more than 20. They include the Distinguished Conduct Medal, the Conspicuous Gallantry Medal, the George Medal, the Police Medal for Gallantry, and the British Empire Medal. The Conspicuous Gallantry Medal is awarded to warrant officers and members of the Royal Navy, Royal Marines, and merchant navy.

**War medals** include all medals and stars for service during wars and campaigns. An example is the 1939-1945 Star for service during World War II.

**Other awards** are made by Commonwealth countries. Australia instituted its own order, the Order of Australia, in 1975. It has military and civilian divisions, each with five classes. Australia issued its own medal for service in the Vietnam War.

India modelled its honours on the British pattern. It awards the Bharat Ratna (Jewel of India) to Indian citi-



## Decorations and medals from around the world



Grand Cordon of the Supreme  
Order of the Chrysanthemum  
(Japan)



Order of Merit of  
the Italian Republic  
(Italy)



Royal Order of the Seraphim  
(Sweden)



Order of the  
Aztec Eagle  
(Mexico)



Victoria  
Cross  
(Great Britain)



Military Order  
of William  
(Netherlands)



Order  
of  
Canada



Iron  
Cross  
(Germany)



Legion  
of Honour  
(France)



Medal of Honor  
(Army)  
(United States)



Purple Heart  
(United States)



**The Order of Australia**, instituted in 1975, honours Australians for distinguished civil or military service.



**The George Medal**, a British award, can be won by civilians and members of the services for great heroism.



zens who have done exceptional work in art, literature, or science, or public service. Param Vir Chakra is for outstanding gallantry in the presence of the enemy. India and Pakistan both issued independence medals.

New Zealand issued a gallantry medal for service in the Maori Wars of the 1860's. Only 25 were awarded.

### Other countries

Thousands of different decorations, medals, and orders are awarded by the countries of the world. Here is a selection of some of the most important.

**Africa.** Kenya awards the Order of the Golden Heart of Kenya to citizens of Kenya and foreigners who have performed exceptional service to the country. Malawi gives the Order of the Lion of Malawi to foreigners and citizens of Malawi who have performed distinguished and outstanding service to Malawi. Morocco's highest award is the Order of Muhammad. The Order of Muhammad award is given to members of the royal family, foreign heads of state, and civil and military leaders for exceptional service to Morocco. The Order of Good Hope is South Africa's highest order. It is awarded to civilians and members of the armed forces of foreign countries, and also to South African citizens who have worked to promote the country's international relations.

**Austria** has an Order of Merit, divided into 13 classes. Its most famous order was the Order of the Golden Fleece, founded in 1430 by Duke Philip the Good of Burgundy. Because the Austrian and Spanish royal families included descendants of Duke Philip, those countries later adopted the order. But it is no longer awarded.

**Belgium's** decorations include the Order of Leopold, founded in 1832, the Croix de Guerre (war cross), and the Civic Cross.

**China** has a number of orders commemorating the Communist revolution of 1949 including the Order of Freedom. It awards many medals, including the Energetic Tiger Merit Medal for soldiers, and the Cloud Dragon Medal for air crew.

**Denmark** has one of the oldest orders, the Order of the Dannebrog, created in 1219 and revived in 1671. It is given to Danes and foreigners for distinguished service in civilian and military affairs.

**France's** highest award is the Legion of Honour. This award was instituted by Emperor Napoleon I in 1802. It was the first order based solely on merit, and is open to all citizens, and to foreigners, for gallantry or civil achievement. Military awards include the Médaille Militaire and the Croix de Guerre.

**Germany.** An Order of Merit with several classes is the main award. There are also awards for life-saving. Germany's most famous military award was the Iron Cross, established by King Frederick William III of Prussia in 1813.

**Japan.** The Supreme Order of the Chrysanthemum is Japan's highest award. It is given to Japanese royalty, nobility, and foreign heads of state (male only). It was founded in 1876, as was the Order of the Rising Sun.

**Latin America.** The countries of this region have many orders and medals. Argentina has the Order of San Martín, awarded only to foreigners. Bolivia's highest award is the National Order of the Condor of the Andes. It is given to Bolivians and foreigners for exceptional

civil or military merit. Brazil retains the Order of the Golden Cross, which belonged to the former colonial power, Portugal, and has a Red Cross Medal. Chile has the Order of Bernardo O'Higgins, its national hero. Cuba's Order of Paya Giron was founded by President Fidel Castro. Mexico awards the Order of the Aztec Eagle to foreigners who have given distinguished service to Mexico. Peru's Order of the Sun of Peru was established in 1821. Venezuela has the Order of Simon Bolívar, named after its hero of independence.

**Middle East.** Lebanon gives the National Order of the Cedar to foreigners and to Lebanese for exceptional service or for acts of extreme courage. Egypt's highest award is the Order of the Nile. This award is given to Egyptian citizens and foreigners for distinguished military or civilian service. Israel gives the Medal for Valour to members of the armed forces for heroism.

**The Netherlands** has the Order of the Lion and the Military Order of William (both founded in 1815), and the Order of Orange-Nassau, besides military and civilian medals.

**Spain** has a number of orders, including the Order of Charles III, founded in 1771, and the Order of Isabella the Catholic. In former times, Spain shared with Austria the Order of the Golden Fleece.

**Thailand's** greatest honour is the Most Illustrious Order of the Royal House of Chakri. Membership is limited to 43 people who have performed outstanding service to Thailand.

**The United States.** The highest American military decoration is the Medal of Honor, sometimes called the Congressional Medal of Honor. The oldest is the Purple Heart, established by George Washington in 1782. It was first awarded to soldiers of the Revolutionary War in America for unusual bravery. It was revived in 1932 and is awarded to members of the armed forces who have been killed or wounded in action. Other awards include the Distinguished Service Medal, the Silver Star, and the Distinguished Flying Cross. The highest civilian award is the Presidential Medal of Freedom.

### Wearing decorations and medals

The higher classes of orders generally have elaborate insignia, such as crosses, stars, and sashes. Lower classes have simpler insignia. Decorations and medals generally are suspended on a short length of ribbon, with a different pattern for each decoration.

### Notable decorations, medals, and orders

Award	Year established	Country
Victoria Cross	1856	Britain and Commonwealth
George Cross	1940	Britain and Commonwealth
Legion of Honour	1802	France
Order of the Garter	1348	Britain
Sign of Halder	1958	Pakistan
Ancient Order of Sikatuna	1951	Philippines
Medal of Honor	1861	United States
Purple Heart	1782	United States
Order of Australia	1975	Australia
Hero of Israel	1949	Israel
Order of Pius	1847	The Vatican
Order of	1949	China
Socialist Labour Order of Good Hope	1973	South Africa



Among Western nations it is the custom for people to wear their full decorations, medals, and orders only on formal occasions. Service personnel in uniform wear a thin strip of the ribbon for each decoration or order stitched to the breast of the jacket. But in some other countries, such as the Soviet Union, it is customary for service personnel to wear medals and other decorations at all times.

### History

Since the beginning of history, monarchs and heads of state have rewarded individuals for bravery and merit. The ancient Greeks rewarded military and athletic heroes with wreaths made of laurel leaves. The tradition of the laurel wreath has had a lasting influence. Today, many medals have an image of a laurel wreath surrounding an inscription or the *bust* (sculpted head) of a head of state.

The ancient Romans crowned their heroes with gold laurel wreaths. Gold collars, chains, medallions, and arm rings were also awarded for outstanding bravery. The most significant award was the *phalera*, a gold or silver disc formed into the head of a god, man, or animal. These awards were given for bravery in battle and represented an early stage in the development of breast stars and chest decorations.

Knights of the Middle Ages formed orders. Each order created a distinctive badge that displayed the symbol of the order. A knight wore the badge on a chain around his neck. Knights also received medals of gold, silver, or bronze. These round medals were meant to be displayed on a table, not worn.

The first ribboned medals, similar to today's medals, appeared in Austria and Russia during the 1600's. Most of these types of medals celebrated participation in famous battles, and they were generally awarded only to military officers.

By the mid-1800's, almost every country in Europe had at least one national order for merit. Orders were created to reward merit in many fields, including the arts, science, and agriculture, as well as for military and civil merit. During the last half of the 1800's, trade and the expansion of colonial empires led much of the rest of the world to adopt awards systems based on those of Western Europe.

See also **Knighthood**, **Orders of**; **Knights and knight-hood**.

**Decorative arts** is a term used to designate a variety of categories including furniture, woodwork, and glass. The term decorative arts also refers to ceramics (porcelain and earthenware) and metalwork (gold, silver, bronze, and other metals).

The decorative arts are called the *applied arts* when referring to objects intended for actual use such as chairs, silver flatware, porcelain dishes, and glass vessels. *Minor arts* is another term occasionally used for decorative arts. This term does not mean that the decorative arts are inferior to other forms. It is intended to separate decorative arts from the *fine arts* of painting, sculpture, and architecture.

The decorative arts reflect the desire throughout human history to decorate the environment. For example, prehistoric peoples created small ivory sculptures. The Egyptians buried finely crafted furniture and jewel-



**A masterpiece of the decorative arts**, this Easter egg was crafted by the Russian jeweller Peter Carl Fabergé in 1890.

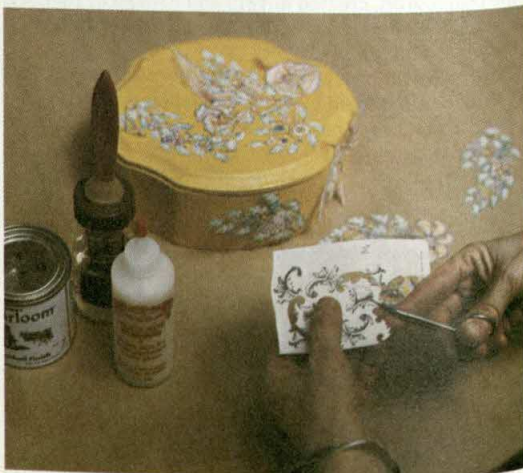
ery with their dead. During medieval times, artisans decorated castles and churches with articles made from ivory, gold, and enamel. Artists of the Renaissance produced fine furniture, metalwork, and glass. People of the 1700's created beautiful porcelain pieces and carved woodwork. Today, the decorative arts continue to be an important division of art. Fine art and decorative art reflect important artistic trends in their form, colour, and material.

**Related arts** in *World Book* include:

Beadwork	Furniture	Ironwork,	Mosaic
Ceramics	Gilding	Decorative	Pottery
Decoupage	Inlay	Ivory	Stained glass
Enamel	Interior	Jewellery	Tapestry
	decoration	Lace	

**Decorator.** See **Interior decoration**.

**Decoupage** is the art of using paper cutouts to decorate furniture and such accessories as boxes, lamps,



**Decoupage** is the art of decorating furniture and accessories with paper cutouts. The cutout is glued to a surface and covered with many coats of varnish. The final coat is waxed and polished.



plaques, and trays. The finished object looks and feels like fine enamel. Cutouts can be taken from such articles as calendars, greeting cards, magazine and newspaper illustrations, photographs, and wrapping paper. The word *decoupage* comes from the French word *decouper*, meaning to cut out.

Decoupage usually involves four steps. First, the surface of the object to be decorated must be sanded and, if wood, painted or stained. A protective sealer is applied to the cutout, which is then glued to the object. Next, the decorated surface is covered with many coats of varnish until the edge of the cutout cannot be felt. Last, the final coat of varnish is smoothed, polished, and waxed.

See also Enamel; Varnish.

**Deductive method** is the process of reasoning by which we draw conclusions by logical inference from given premises. If we begin by accepting the propositions that "All Greeks have beards" and that "Zeno is a Greek," we may validly conclude that "Zeno has a beard." We refer to the conclusions of deductive reasoning as *valid*, rather than *true*, because we must distinguish clearly between *that which follows logically* from other statements and *that which is the case*.

Starting premises may be articles of faith, assumptions, or conclusions based on earlier reasoning. In order to draw valid conclusions, the deductive method uses a special set of rules. These rules are based on the structures of premises and conclusions. Mathematics and logic make extensive use of the deductive method. The scientific method requires a combination of induction and deduction (see **Inductive method**).

See also Logic; Science (Mathematics and logic).

**Dee** is the name of five rivers in either Britain or Ireland. The best known of these rivers rises in Wales at Lake Bala, in Gwynedd, flows through Clwyd, and then forms part of the border between Wales and England. It continues through Cheshire before it eventually empties into the Irish Sea. The river is about 110 kilometres long.

Scotland has two rivers called Dee. The longer one rises in the Cairngorm Mountains and flows mainly in Grampian Region and provides much of Aberdeen's water. It empties into the North Sea at Aberdeen. Its lower valley is known as *Deeside*. The river is about 145 kilometres long. The shorter Scottish Dee rises in Loch Dee in Dumfries and Galloway Region and flows south into the Solway Firth. It is about 80 kilometres long.

England has a River Dee that flows into the River Lune in Cumbria.

In the Republic of Ireland, the River Dee flows into Dundalk Bay in County Louth.

See also Clwyd; Dumfries and Galloway Region; Grampian Region; Gwynedd.

**Deed** is a written document to transfer ownership of property. The deed must be signed by the party transferring ownership. In many cases, it is also signed by the party receiving ownership. The deed must describe the property transferred and show the intent to transfer ownership. The deed takes effect only when it is delivered to the party receiving ownership.

Deeds may also be made out for the transfer of a *legal right* such as a share in a company or a claim to money under an insurance policy. Contracts made by deed are enforceable without *consideration*.

Deeds must be *sealed*, in addition to being signed and delivered. A seal is a wax impression used to authenticate the deed.

See also Contract.

**Deep** refers to any ocean area that has a depth of more than 5,490 metres. More than 100 deeps have been discovered in ocean floors. Contrary to popular belief, they are not found in the centre of the ocean. Most of them occur close to mountainous islands where steep shores plunge down to the bottom of the sea.

The deepest known ocean deep is located in the Mariana Trench 320 kilometres southwest of Guam in the Pacific Ocean. There, the ocean floor is 11,033 metres below the surface. The Milwaukee Deep, part of the Puerto Rico Trench north of Puerto Rico, has the greatest recorded depth in the Atlantic Ocean. This deep was found in 1939 and has a depth of 8,648 metres.

See also Atlantic Ocean (The ocean bed); Ocean (The world ocean; The land beneath the sea); Pacific Ocean (Location and size).

**Deep-sea animals.** See Fish (pictures: Fish of the deep ocean); Ocean (pictures).

**Deep-sea diving.** See Diving, Underwater.

**Deep Sea Drilling Project.** See Atlantic Ocean (People and the Atlantic).

**Deeping, Warwick** (1877-1950), an English novelist, wrote his most famous book, *Sorrell and Son* (1925), as a result of his experiences in World War I. He wrote more than 40 novels, including *Old Pybus* (1928), which also gained wide popularity. His characters were drawn from real people, and his novels have happy endings. George Warwick Deeping was born at Southend, in Essex. He graduated from Trinity College, Cambridge University, then studied medicine at Middlesex Hospital near London. Deeping practised as a doctor for a year then abandoned medicine for a career in literature.



The River Dee flows through beautiful scenery near Llangollen, in Wales. The river empties into the Irish Sea.





A mother white-tailed deer guards her fawns while they search for food. Fawns may stay with their mothers for more than a year.



New antlers of a white-tailed deer, above, and moose, below, have a furry cover called *velvet* which the animals soon rub off.



**Deer** are the only animals with bones called *antlers* on their heads. Antlers differ from horns, which are strong, hard layers of skin with a bony core. Deer are among the most common large land mammals and are well known for their running ability.

There are more than 60 species of deer in the world, including caribou, elk, marsh deer, moose, mule deer, musk deer, reindeer and roe deer. Some deer live in the hot, dry deserts. Others live in cold regions above the Arctic Circle. However, most species of deer live in grasslands, swamps, or woodlands that have a mild climate.

Deer vary widely in size. They are among the largest wild animals in Europe and North America. The North American moose is the largest deer in the world. Some males grow 2.3 metres tall at the shoulders and weigh over 815 kilograms. The smallest deer is the pudu of western South America. It is about 30 centimetres tall at the shoulders and weighs about 9 kilograms.

Among most species of deer, only the males have ant-

lers. In caribou and reindeer, however, both males and females have antlers.

Most male deer are called *bucks*. But male caribou, elk, and moose are called *bulls*, and male red deer are called *stags* or *harts*. Most female deer are called *does*. But female caribou, elk, and moose are called *cows*, and female red deer are *hinds*. Most young deer are called *fawns*, but young caribou, elk, and moose are called *calves*.

Since early times, people have used deer meat for food and deer skins for clothing. After white people settled in North America, they killed so many deer that the animal was wiped out in large regions of the continent. In some areas, deer populations recovered after the animals were reintroduced from other regions and protected by hunting laws. However, hunting laws fail to protect many of the animals that prey on deer in North America, such as coyotes and cougars. These predators are now scarce or absent in some areas where deer live, and some deer populations have grown too large. As a



result, today many deer are killed simply to reduce their numbers.

### The body of a deer

Deer are *mammals*—that is, animals whose young feed on milk produced by the mother. Like other mammals, deer are *warm-blooded*, which means their body temperature remains fairly constant regardless of the surrounding temperature. Deer have a covering of hair on the body that helps keep them warm in cold weather. Reindeer and caribou of the Far North have a thick coat of hair. Most other deer have shorter, shiny hair that lies flat so that the animals' coat looks smooth. Deer in tropical regions have a much thinner coat.

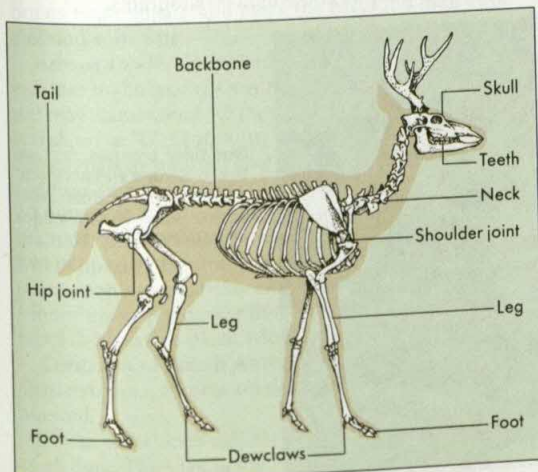
**Legs and hoofs.** All deer have long, thin legs and are good runners. They move their legs rapidly and take long strides. A deer's foot is really two centre toes. Each of the two toes is protected by a hard covering called a *hoof*. A deer runs on tiptoe with a springing or bouncing motion. Two other toes, called *dewclaws*, grow higher on the leg and have no use when the animal runs. The dewclaws often leave dots at the back of a deer's track in snow.

Deer use their speed to avoid predators. A frightened white-tailed deer can run as fast as 65 kilometres per hour and can leap 4.5 to 6 metres forward. Even the moose, with its large, powerful body, can run about 30 kilometres per hour.

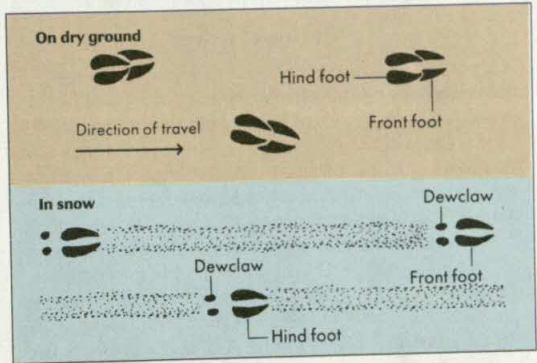
**Head.** Deer have narrower heads and somewhat smaller noses and mouths than do cattle. The deer's lips move easily, and the animal uses them to grasp food. Most kinds of deer have only bottom teeth in the front of the mouth. A thick pad of rough skin takes the place of upper front teeth. The lower teeth press against this pad of skin when the deer tears off leaves and twigs to eat. The upper and lower back teeth have many sharp-pointed tips. The deer uses these teeth to chew its food.

A deer has large eyes at the sides of its head. However, the animal depends on its ears and its nose to catch the first warnings of danger. A deer has keen hearing and smell. Its large ears are always erect, and they can be moved to catch sounds from any direction. A

### The skeleton of a deer



### The tracks of a deer



deer can identify the direction from which a sound is coming. A deer usually faces into the wind when it eats or rests. The wind carries sounds and smells of approaching predators.

**Antlers** are outgrowths of bone that are part of a deer's skull. Their hard, bony structure and sharp points make them extremely dangerous weapons. Male deer use antlers chiefly to fight for mates or for leadership of a herd. Deer that live in mild or cold climates shed their antlers each winter and begin to grow a new set in late spring. Deer that live in warm or hot climates may lose their antlers and grow new ones at other times of the year.

New antlers are soft and tender and grow rapidly. A thin layer of skin grows over the antlers and stimulates their development. This skin layer is called *velvet* because it is covered by short, fine hairs that give it a soft appearance. As the antlers reach full size, the velvet dries and the deer scrapes it off on the ground or against trees or bushes.

All antlers have branches that end in *tines* (points or prongs). But the shape of the antlers varies among species of deer. Moose and caribou are easy to distinguish from other deer by the antlers alone. Moose antlers have areas that are broad and flat. In caribou, a branch of one antler extends forward above the nose of the animal.

The size and shape of a deer's antlers depend on the animal's size, age, and health. A deer first grows antlers when it is age one or two. In most deer, these first

### How a deer's antlers grow

Deer lose their antlers each winter and begin to grow new ones in late spring. The new antlers are soft and tender. Thin skin with short, fine hairs called *velvet* covers the growing antlers. Full-grown antlers are hard and strong, and have no velvet.





antlers are short and somewhat straight. Each year, the antlers grow longer and larger, and form branches.

### The life of a deer

Deer have no permanent homes, dens, or nesting sites. They spend their lives roaming an area called a *home range* in search of food. Deer also claim and defend areas within the home range to attract mates. Deer may live in groups or alone, depending on their age, sex, and species. Moose spend most of their time alone. But caribou may form herds with up to 100,000 animals.

Many deer move to more favourable locations when the seasons change. Deer that live in the mountains move to lower lands for the winter. These deer usually stay near the edges of forests. There, trees and grasses supply food, and bushes serve as a place to sleep, to hide from predators, or to give birth.

Some deer migrate long distances each year. Caribou may travel 1,600 kilometres between feeding grounds. They spend the summer in the flat, marshy land of the Arctic Circle. In late summer, they gather in large herds and travel to warmer areas for the winter. In early spring, the caribou return north.

**Young.** A female deer carries her young inside her body for about six to nine months, depending on the species. She chooses a hidden spot away from other deer to give birth. The young deer remain hidden until they can walk well enough to follow their mother.

Fawns of the European roe deer weigh 2 kilograms at birth. They stay hidden for one to three weeks. Newborn moose calves weigh about 11 to 16 kilograms. They can follow their mother when they are about 10 days old. Reindeer and caribou calves weigh about 4.5 kilograms at birth. They can walk with the herd several hours later.

Most kinds of deer have one young at a time. Occasionally, twins are born. Chinese water deer, which live along the Yangtze River, give birth to the most young—four to seven fawns at a time.

**Food.** Deer eat a wide variety of plants and plant parts. In spring, when food is relatively plentiful, deer eat mostly grasses, flowers, buds, and young leaves. In summer, when grasses and leaves dry up, deer eat twigs, stems, and mature leaves. In winter, deer often gather in small herds and tramp the snow on their feeding grounds to reach twigs and small tree branches.

When food becomes extremely scarce, deer will feed on bark and other hard parts of trees.

Deer do not chew their food well before swallowing it. A deer's stomach has four chambers. One chamber serves as a storage place, which enables deer to eat large amounts of food quickly. Thus, deer do not need to spend long periods at their feeding grounds, where predators might see them. Later, when a deer has found a safe place, the stored food is returned to the mouth in a ball-like glob. The deer then chews this food, called *cud*. After the chewed food has been swallowed, it goes to other parts of the stomach. Animals that digest their food in this way are called *ruminants* (see Ruminant).

**Habits.** Deer use their keen senses, their knowledge of their home range, and their speed to avoid enemies. A healthy deer can outrun most predators, including bears, cougars, wolves, and human beings. But a deer's primary means of escaping danger is to avoid detection. Unless startled, most deer will stand motionless and let a predator pass by. Most deer feed only at dawn and dusk at the edges of forests, where they blend in best with their surroundings.

Wild deer live 10 to 20 years. In captivity, some deer live longer. However, the roe deer lives 10 to 12 years in the wild but only 3 to 7 years in a zoo.

### Kinds of deer

There are more than 60 species of deer. They live in Asia and Europe, North America, and Central and South America. Deer also have been introduced into places where they did not live naturally, including Australia, Hawaii, New Guinea, and New Zealand. In Australia, several types of deer are farmed including fallow deer, red deer, and Asian rusa deer. The deer are farmed for their meat (venison) and for their *velvet* (furry covering of the new antlers). The velvet is processed for use in Asian medicines. In New Zealand the red deer is the most common species farmed.

**North American deer.** The best-known deer of North America include (1) white-tailed deer, (2) mule deer, (3) caribou, (4) elk or wapiti, and (5) moose.

**White-tailed deer,** also called *Virginia deer*, are the most common large game animals of North America. A fully grown male white-tailed deer may stand a metre tall at the shoulders and weigh 90 kilograms.



**Roe deer** are small deer native to Europe and northern Asia. They prefer open areas such as scrub and the edges of woods and forests.





An American elk stands alert for danger in the grassy high mountain meadow that is its summer feeding area.



A herd of reindeer scrambles over the rocky ground of the Arctic regions to find grass and moss to eat.

The deer's tail, after which it is named, grows about 30 centimetres long. The tail has brown hair on top and white hair underneath. When the deer is frightened and begins to run, its tail stands straight up, showing the white part. This deer has a reddish-brown coat in summer and a grey or bluish-grey coat in winter.

**Mule deer**, also called *black-tailed deer* in the Pacific Northwest, are much like white-tailed deer. Mule deer are named after their large, furry ears, which look somewhat like those of a mule. Buckskin was originally made from the hides of mule deer and white-tailed deer.

**Caribou**, which live in northern North America, are closely related to the reindeer. Unlike all other deer except reindeer, both males and females have antlers. Caribou grow about 1.2 metres high at the shoulders and vary in colour from white to grey or brown. Arctic Eskimos and Indians eat caribou meat, carve the animal's bones into utensils, and make the caribou's hide into clothing and tents.

**American elk**, also called *wapiti*, are the second largest deer in the world. Only moose are larger. Male wapiti may stand about 1.5 metres at the shoulder and weigh up to 500 kilograms. They form herds with up to 500 animals in summer and 1,000 animals in winter.

**Moose** are the largest of all deer. Some males stand 2.3 metres at the shoulders and weigh up to 815 kilograms. Their antlers may measure 1.4 metres wide and weigh up to 27 kilograms. In spite of its large size, a moose can move quickly and quietly through the forest. Moose are much darker than other deer, ranging from reddish-brown to black. Moose normally live alone.

**Central and South American deer** include (1) pudu, (2) marsh deer, (3) brocket deer, (4) pampas deer, and (5) huemul.

**Pudu**, sometimes called *rabbit deer*, are the smallest of all deer. They live in the forests of western South America from sea level to altitudes of about 3,000

metres in the Andes Mountains. Pudu grow only about 30 centimetres high and weigh about 9 kilograms. They have short, spiky antlers. Their rough, brittle hair is brown or grey. Pudu are probably the shyest deer.

**Marsh deer** are the largest South American deer. They grow about 1.2 metres high. These deer live in the swampy plains and forests of Brazil, Paraguay, and Uruguay. They can spread each hoof wide to help them walk on the soft ground.

**Brocket deer** live from southern Mexico to Paraguay, in wooded areas from sea level to altitudes of 4,880

### Some members of the deer family

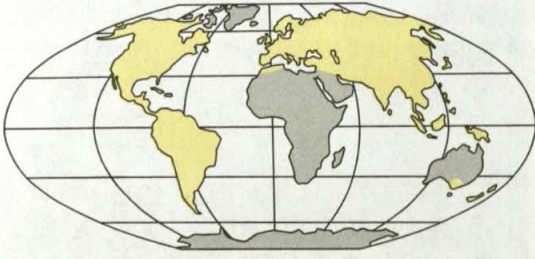
Common name	Scientific name	Where found
<b>Brocket deer</b>	<i>Mazama</i>	Central America
<b>*Caribou and reindeer</b>	<i>Rangifer tarandus</i>	Asia, Europe and North America
<b>Chinese water deer</b>	<i>Hydropotes inermis</i>	Asia
<b>Chital (Axis deer)</b>	<i>Axis axis</i>	Asia
<b>Fallow deer</b>	<i>Dama dama</i>	Asia and Europe
<b>Huemul (Andean deer)</b>	<i>Hippocamelus</i>	South America
<b>Marsh deer</b>	<i>Blastocerus dichotomus</i>	South America
<b>*Moose/Elk</b>	<i>Alces alces</i>	Asia, Europe, and North America
<b>*Mule deer (Black-tailed deer)</b>	<i>Odocoileus hemionus</i>	North America
<b>*Musk deer</b>	<i>Moschus moschiferus</i>	Asia
<b>Père David's deer</b>	<i>Elaphurus davidianus</i>	Asia
<b>Pudu</b>	<i>Pudu</i>	South America
<b>*Red deer</b>	<i>Cervus elaphus</i>	Europe
<b>Roe deer</b>	<i>Capreolus capreolus</i>	Asia and Europe
<b>*Wapiti (American elk)</b>	<i>Cervus canadensis</i>	North America
<b>White-tailed deer (Virginia deer)</b>	<i>Odocoileus virginianus</i>	North America

\*Has a separate article in WORLD BOOK.



**Where deer live**

The yellow areas of the map show the parts of the world in which deer live. Deer live on every continent except Antarctica.



metres. They grow about 50 centimetres high at the shoulders. Their antlers look somewhat like spikes.

**Pampas deer** are named after the tall pampas grasses of the South American plains in which they live. These deer grow about 90 centimetres high at the shoulders and have reddish-brown or yellowish-brown hair. The male has glands in its back hoofs that give off a strong odour.

**Huemul**, or *Andean deer*, are found in the Andes Mountains from Ecuador to southern Argentina. They live in thick forests and grassy plateaus at altitudes of about 5,000 metres. Huemul grow about 90 centimetres high at the shoulders and have speckled coats of grey, yellow, and brown. The hair is rough and brittle, and grows longest on the forehead and tail.

**Asian and European deer** include (1) musk deer; (2) muntjac; (3) chital, or axis deer; (4) fallow deer; (5) red deer; (6) reindeer; and (7) Père David's deer.

**Musk deer** roam the forests of the mountains and high plateaus of central and northeastern Asia. They grow about 55 centimetres high at the shoulders and have no antlers. Two tusklike teeth grow downward from the top jaw of the male. The deer are named after an oily substance called *musk*, which is produced by a gland in the skin of the male's abdomen. Musk is used in perfume.

**Muntjac** live in jungle areas in India, Nepal, Sri Lanka, southern China, and throughout most of Southeast Asia. They stand about 50 centimetres high at the shoulders. These deer make a barking noise when they are frightened and are sometimes called *barking deer*.

**Chital**, or *axis deer*, are found in the grasslands and open forests of India and Sri Lanka. Some people consider them the most beautiful and graceful of all deer. Chital grow about 90 centimetres high at the shoulders. Their sleek reddish-brown coats are spotted with white. Their antlers, which grow about 90 centimetres long, curve gracefully back from their heads. Like the male musk deer, male chital have two tusklike teeth that grow from the upper jaw. These deer are found in many zoos.

**Fallow deer** originally lived only in lands along the Mediterranean Sea. Today, they may be found in most parts of Europe. Many are kept in herds on estates or in parks. Fallow deer are about as large as chital. Unlike most European deer, they have broad, flat antlers shaped somewhat like those of the moose.

**Red deer** stand at about 1.2 metres high at the shoulders and have reddish-brown hair. Red deer are famous for their beauty.

Deerstalking is a form of hunting for wild red deer, popular in Scotland. The red deer found in the Scottish Highlands have a keen sense of smell and good eyesight, and take alarm at the slightest sound. Stalking involves approaching the deer cautiously, so that the stalker can get near enough to shoot successfully.

**Reindeer**, which live in the Arctic and in the northern regions of Europe and Asia, look like caribou. The male and female both have antlers. Reindeer are among the most important animals of the Far North. People eat reindeer meat, make clothing and tents from the hide, and carve utensils from the antlers and bones.

**Père David's deer** once roamed the plains and marshes of northern China. They are named after a French priest who first saw the deer in 1865. Today, only about 400 of these deer are still alive. They live in private parks and zoos in many parts of the world. All are related to deer that were brought to England about 1900 from a herd kept by the Chinese emperor in Beijing. The original herd in China died out in 1921, but the English herd did well. Père David's deer stand about one metre high at the shoulders and have a greyish-tan coat in winter and a reddish-tan coat in summer.

**Endangered species.** In the late 1880's, more than 20 species of deer were endangered with extinction. These species included Columbian white-tailed deer, key deer, marsh deer, and five kinds of Asian sikas. Many countries have banned deer hunting and have set up game preserves to protect the animals. Today, the destruction of natural habitats poses the greatest threat to deer populations. People have cleared away many areas where deer live so that the land can be used for agricultural and housing developments.

**Scientific classification.** Deer are members of the class Mammalia and belong to the order of even-toed hoofed animals, Artiodactyla. They make up the deer family, Cervidae.

**Study aids****Related articles in World Book include:**

Animal (pictures)	Caribou	Moose	Musk deer
Buckskin	Elk	Mule deer	Red deer
	Hunting	Musk	Reindeer

**Outline****I. The body of a deer**

A. Legs and hoofs	B. Head	C. Antlers
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**II. The life of a deer**

A. Young	C. Habits
B. Food	

**III. Kinds of deer**

A. North American deer	C. Asian and European deer
B. Central and South American deer	D. Endangered species

**Questions**

How many species of deer are there?  
 What are antlers? How do they grow?  
 How far can a deer jump?  
 What do deer eat?  
 Which is the largest deer? The smallest?  
 How many toes does a deer have?  
 What are young reindeer or caribou called?  
 Why does a deer face the wind when it eats or rests?  
 How do deer avoid enemies?



**Deer fly** is an insect related to the horseflies. It has brown, blotched or banded wings and brilliantly coloured eyes. Deer flies are 8 to 13 millimetres long. They live in all parts of the world except Australasia. Only the females bite people. In the western part of the United States, the name *deer fly* is given also to the *snipe fly*. These flies have two wings and six long legs. They suck blood from people and animals. Some deer flies carry diseases. A person may use mosquito repellents to avoid deer fly bites.



Deer fly

**Scientific classification.** The deer fly is a member of the horsefly family, Tabanidae. It is classified as genus *Chrysops*.

**Deere, John** (1804-1886), was an American inventor and manufacturer. In 1837, he invented the first steel plough that efficiently turned the heavy American prairie soil. He became one of the world's greatest plough manufacturers.

Deere was born in Rutland, Vermont. He became a blacksmith's apprentice at the age of 17. In 1836, he opened a blacksmith shop in Grand Detour, Illinois. He soon learned that nearby farmers were dissatisfied with their ploughs. The heavy, sticky prairie soil stuck to the rough surface of the wood or iron mouldboard that was used to turn the soil.

Deere built a smooth, hard mouldboard out of an old circular steel saw in 1837. The new mouldboard worked just as he had hoped. The soil fell away cleanly in furrows and polished the surface of the mouldboard as it turned. Deere and a partner, Leonard Andruss, began

making quantities of steel ploughs. Within 10 years, they were producing 1,000 ploughs annually. In 1847, Deere sold his interests to Andruss and started a new company in Moline, Illinois. To improve the quality of his ploughs, Deere ordered a special type of hard steel from England. He then had a similar type of steel made in Pittsburgh. This project resulted in the first plough steel ever manufactured in the United States. By 1857, Deere was producing 10,000 ploughs a year. The business was incorporated as Deere and Company in 1868. Besides ploughs, the company's other products include machinery such as bulldozers, fork-lift trucks, tractors, and garden implements, such as mowers. Today the company ranks as one of the largest industrial corporations in the United States.

See also **Plough** (The sulky plough).

**Deerhound** is a Scottish breed of dog, close to the Irish wolfhound in ancestry. It was named after its skill at deer hunting, and it was bred to hunt game by sight. Today, it is seldom used for hunting. The deerhound is a member of the hound class of dogs. It measures from about 70 to 80 centimetres tall at the shoulder and weighs from about 35 to 50 kilograms. The coat of the deerhound is 8 to 10 centimetres long and is coarse and wiry. It may be grey or tan, with dark streaks or spots. The deerhound is a rugged but graceful dog. It makes an excellent pet.

**De Falla, Manuel.** See Falla, Manuel de.

**Defamation.** See Libel.

**Defence, Civil.** See Civil defence.

**Defence mechanism.** See Neurosis (Neurosis is a psychological mechanism).

**Defender of the Faith** is one of the titles used by British sovereigns. In 1521, Henry VIII wrote in defence



**John Deere, above,** became one of the world's leading manufacturers of ploughs. His Gilpin sulky, *right*, named after its designer, Gilpin Moore, was the first commercially successful riding plough (introduced in 1875).





of the Roman Catholic Church against the German Protestant reformer Martin Luther. As a reward, Pope Leo X gave Henry the title *Fidei Defensor* (Defender of the Faith), which he had requested. In 1544, the title was confirmed by Parliament for perpetual use by British sovereigns.

The title appears on some coins as *Fid. Def.* or *F.D.*, abbreviations of the Latin words *Fidei Defensor*. In the royal title, the phrase "Defender of the Faith" comes immediately after "Head of the Commonwealth."

**Defenestration of Prague.** See *Thirty Years' War* (The Bohemian period).

**Deficiency disease.** See *Nutrition* (Results of malnutrition); *Disease* (Nutritional diseases).

**Defoe, Daniel** (1660-1731), was an English novelist and journalist. He wrote *Robinson Crusoe*, one of the first English novels and one of the most popular adventure stories in Western literature. Some critics have called Defoe the father of the English novel. Others rate him as much less important. But he was one of the great masters of realistic narrative long before such writers as Theodore Dreiser and Ernest Hemingway.

**His life.** Defoe was born in London, the son of a butcher and candle merchant. He started a business career, but he went bankrupt and turned to writing. His earliest writings dealt with such controversial subjects as politics and religion. A political pamphlet led to his imprisonment in 1703 for about four months.

For about 25 years, Defoe earned his living writing for newspapers. He produced his own periodical, *The Review*, single-handedly from 1704 to 1713. Many politicians hired him to write for newspapers. At times he was secretly writing for the Whig Party in one paper and the Tories in another. Not much is known about his last years, but he continued to write much political journalism, as well as other kinds of work.

**His writings.** Defoe is unique in the quantity and variety of his works. It is difficult to tell how many works he produced, because most were published anonymously. The latest estimate of the number is about 550, including works of poetry, theology, economics, and geography.

For most readers today, Defoe is known primarily as a novelist. However, this was really a minor part of his writing, and not the part that gave him the most pride. Defoe's two most famous novels are *Robinson Crusoe* (1719) and *Moll Flanders* (1722).

Defoe's novels reflect the growing power and wealth the new English middle class developed through new business opportunities at home and abroad. Many of this new class were Puritans and they tended to believe in the glory of hard work and getting ahead through one's own efforts. The Puritans also stressed education, and therefore became a large part of the reading public. So for the first time, Defoe and other writers treated trade, capitalism, and individualism favourably.

*Robinson Crusoe* is the story of a man marooned on an island. It is a memorable adventure story and a study of what it is like to be truly alone. It is also a success story, because Crusoe's hard work, inventiveness, and ability to take advantage of others turns his island into a successful colony. See *Robinson Crusoe*.

*Moll Flanders* has been generally accepted as Defoe's best example of a genuine novel. *Moll Flanders*, the

heroine, is a thief and a prostitute. Although her surroundings differ from those of Robinson Crusoe, there are basic similarities between the two characters. They both seem like real persons determined to get ahead and gain security. And eventually they both repent of their sins, and end very prosperously.

Defoe's novels marked an important break with the fiction of the past. He offered the ordinary lives of real people who were the normal products of their social and economic surroundings. Defoe makes us believe in the reality of what we are reading as we are hurried from scene to scene by his breathless prose. Only after we have finished do we realize that we have not really been given much psychological insight into the characters.

**De Forest, John William** (1826-1906), was an American novelist. He was born in Seymour, Connecticut, but lived in Charleston, South Carolina, from 1856 until the outbreak of the Civil War in 1861. He then returned to Connecticut to serve as a captain in the Union army.

De Forest wrote about his war experiences and showed his knowledge of the South in his best novel, *Miss Ravenel's Conversion from Secession to Loyalty* (1867). This work and *Kate Beaumont* (1872) established him as one of the earliest realists in American fiction. De Forest's descriptions of war and of small-town Southern life before the war foreshadowed later antiromantic descriptions of the South. But they kept him from gaining a wide audience in his day. De Forest also wrote novels that exposed political corruption and satirized many customs of his time.

**De Forest, Lee** (1873-1961), an American inventor, pioneered in wireless telegraphy and radio broadcasting. He obtained patents on more than 300 inventions. He patented a vacuum tube called a *triode*, or *audion*, in 1907. It often is described as an invention as great as radio itself (see *Vacuum tube*). The vacuum tube, which amplifies weak sounds, was essential to the development of long-distance radio and television communication.

De Forest staged the first musical radio broadcast in history from the Metropolitan Opera House in New York City in 1910. He designed and supervised construction of the United States government's first high-powered naval radio stations.

De Forest moved to the Pacific Coast in 1911. He became interested in sound pictures and diathermy machines. He worked on methods for photographing sound waves on motion-picture films. He was born in Council Bluffs, Iowa.

See also *Electronics* (picture: Lee De Forest).

**Deformity.** See *Birth defect*.

**Degas, Edgar** (1834-1917), was a French impressionist painter. Like the other impressionists, he wanted to portray situations from modern life. However, he did not share his fellow impressionists' enthusiasm for light and colour. Degas emphasized composition, drawing, and form more than did the other members of the movement. See *Impressionism*.

Degas is best known for his paintings of people in both their public and unguarded private moments. He showed his figures in awkward or informal positions to free himself from what he felt strongly were outmoded styles of portraying the human body. But Degas always



composed his pictures carefully to achieve formal balance.

Hilaire Germain Edgar Degas was born in Paris of wealthy parents. From 1854 to 1859, he spent much time in Italy studying the great Italian Renaissance painters to perfect his draftsmanship and style. Degas intended to become a painter of historical scenes, but he abandoned this career because he felt a need to paint modern subjects. Probably under the influence of the painters Gustave Courbet and Edouard Manet, Degas began to paint scenes from everyday life. He especially enjoyed painting pictures showing scenes of racecourse and theatrical life.

During the 1870's, Degas began to use daring compositional techniques, partly influenced by Japanese prints. He placed his figures at unusual angles and used odd visual viewpoints. For example, he tilted his perspective to emphasize a sudden or informal movement by a figure. He even cut off parts of the subjects at the edge of the picture. In the 1880's, Degas started to concentrate on intimate scenes, such as women bathing, shopping, or drying or combing their hair.

Degas painted many pictures in oil, but he also ex-

celled in pastel. His pastel *At the Milliner's* is reproduced in the *Painting* article. Degas was a fine sculptor as well and produced many figurines of clay or wax.

See also **Cassatt, Mary** (picture).

**De Gasperi, Alcide** (1881-1954), leader of the Italian Christian Democratic Party, was prime minister of Italy from 1945 to 1953. His leadership saved Italy from falling under control of the Communists after World War II. He served in the Austrian Parliament from 1911 to 1918. After his home city of Trento became part of Italy in 1919, De Gasperi led the Popular Party in the Italian Chamber of Deputies. He was imprisoned by Benito Mussolini in 1926. He was foreign minister in 1944 and 1945.

**De Gaulle, Charles André Joseph Marie** (1890-1970), became the outstanding French patriot, soldier, and statesman of the 1900's. He led French resistance against Germany in World War II, and restored order in France after the war had ended. De Gaulle guided the formation of France's Fifth Republic in 1958, and served as its president for 11 years until his resignation in 1969.

As president of France, de Gaulle led his country through a difficult period in which Algeria and other



Degas's *Young Dancer* was completed in 1881. The artist now ranks as an important sculptor, but he created statues only to study body movements, not for exhibition.



*The Dancing Class* illustrates how Degas portrayed figures in informal poses. The picture's careful composition and unusual visual viewpoint are typical of Degas's style.



parts of France's overseas empire were granted independence. He fashioned a new role in Europe for France based on close association with a former enemy, Germany. His leadership restored political and economic stability, and again made France one of Europe's leading powers. De Gaulle provided France with a successful constitution, political system, and foreign policy.



Charles de Gaulle

Charles de Gaulle became a symbol of France to the French and to people in other parts of the world. Even his name suggested *Gaul*, the ancient Roman name for France. An imposing figure 193 centimetres tall, de Gaulle was stern and aloof. Some thought him stubborn and arrogant. But de Gaulle had a deep love for France and great confidence in himself. He firmly believed that he was the one man who could make France a world power again.

**Early life.** Charles de Gaulle was born on Nov. 22, 1890, in Lille. His father, Henri, was an officer in the Franco-Prussian War, then taught philosophy, literature, and mathematics. His mother, Jeanne Maillot de Gaulle, came from a literary and military family.

With his sister and three brothers, Charles grew up in an atmosphere that was both military and religious. As a boy, he enjoyed reading stories of famous French battles. When he played soldiers with his friends, Charles always had to be "France."

After studying at the College Stanislas in Paris, de Gaulle served a year in the infantry. He graduated with honours in 1911 from the famous French military school, St. Cyr.

During World War I, de Gaulle was wounded four times. He was captured at Verdun in 1916. After the war, he served with the French Army in Poland, then taught military history at St. Cyr for a year.

In 1921, he married Yvonne Vendroux, a devout Roman Catholic. They had a son and two daughters. Yvonne de Gaulle followed her husband wherever his duties took him, but essentially remained behind the scenes as a housewife and mother.

Between World Wars I and II, de Gaulle held various military commands and taught at the French War College. His book *The Edge of the Sword* (1932) stressed the importance of powerful leadership in war. In *The Army of the Future* (1934), he outlined the theory of a war of movement, in which tanks and other mechanized forces would be used. Most French military leaders ignored this theory. But the Germans studied it carefully and used it to good effect in World War II. De Gaulle's historical study, *France and Her Army* (1938) led to a dispute with his commander, Marshal Pétain.

**Leader of the Free French.** After the Germans invaded France in May 1940, de Gaulle was put in charge of one of France's four armoured divisions. He became undersecretary for war in June. But just days later, on June 22, France surrendered to Germany.

De Gaulle, now a general, escaped to London. He re-

fused to accept the surrender. Nor would he recognize the authority of Marshal Pétain, his former regimental commander and patron, who headed the Vichy government that cooperated with the Germans (see Pétain, Henri Philippe). For this, a French military court sentenced de Gaulle to death. De Gaulle declared that France had lost a battle but not the war. He broadcast such messages to France as: "Soldiers of France, wherever you may be, arise!" His broadcasts stirred French patriotism and kept French resistance alive.

De Gaulle organized the Free French forces in Great Britain and in some of the French colonies. In September 1941, he became president of the French National Committee in London. By 1943, the Allies accepted De Gaulle as the unquestioned leader of the "Fighting French."

**Peacetime leader.** De Gaulle triumphantly entered Paris with the Allies in August 1944. In September, he became head of the provisional government.

De Gaulle got the machinery of government working again during the next 14 months. But France's left-wing parties did not support him, and he resigned in January 1946. He bitterly opposed the constitution of 1946 because it did not provide a strong executive power. In 1947, he organized a new party, the Rally of the French People (R.P.F.), to reform the constitution. But it lost strength after the elections of 1951 and 1956.

He lived at his country home during his retirement. He wrote his World War II memoirs and watched the political situation in France go from bad to worse. In 1957, though he was 67, de Gaulle still hoped that France would recall him. But early in 1958 he admitted, "Now I begin to fear that it is too late."



De Gaulle, leader of the Free French, led a triumphant parade down the Champs-Élysées in August 1944, to mark the liberation of Paris after the German occupation of World War II.



**The Fifth Republic.** Finally, in May 1958, the call came. France stood on the verge of civil war. Dissatisfied French officers, afraid they would lose the government's support against the Algerian rebels, seized power in Algiers. De Gaulle emerged as the only figure likely to prevent domestic chaos. In June, he accepted President René Coty's request to form a government on the condition that he have full powers for six months.

De Gaulle had a new constitution drawn up that established the Fifth Republic. It provided broad powers for the president, who was to be elected for seven years by an electoral college of 80,000 public officials. French voters approved the plan, and the electoral college chose de Gaulle as president in December 1958.

As president, de Gaulle acted with great firmness. After another revolt in Algeria in 1960, he arrested French officers there who had formerly supported him. He negotiated with Algerian nationalist leaders for a cease-fire agreement. The agreement they reached in March 1962, ended more than seven years of bloody war. At de Gaulle's urging, the French people voted almost 10 to 1 in April 1962 for Algerian independence.

The French Assembly ousted the de Gaulle-sponsored government in October 1962. But de Gaulle dissolved the Assembly and obtained the support of a majority coalition. In a separate referendum, the voters also approved de Gaulle's proposal to elect future French presidents by direct popular vote.

In January 1963, de Gaulle and Chancellor Konrad Adenauer of West Germany signed a treaty providing for political, scientific, cultural, and military cooperation. At the same time, de Gaulle blocked Great Britain's entry into the European Community (Common Market). In 1964, France became the first Western power to recognize Communist China. De Gaulle narrowly won a second seven-year term as president in 1965. In 1966, he announced his decision to withdraw French forces from the North Atlantic Treaty Organization (NATO) and remove the NATO headquarters from France. In 1967, de Gaulle again blocked Britain's entry into the Common Market. He also created an independent nuclear strike force.

In 1968, French students and workers staged strikes and demonstrations. The economy suffered from inflation and currency problems, but de Gaulle maintained popular support. In April 1969, however, his proposals for constitutional changes were defeated in a referendum, and he resigned. He retired to Colombey-les Deux-Églises in France, and continued writing his memoirs. De Gaulle died at his home on Nov. 9, 1970, after suffering a heart attack.

**Degree** is a name given to various small units of measure. In geometry and on maps, a degree is a unit of measurement of angles and of arcs of circles. An angle of 1 degree ( $1^\circ$ ) is  $\frac{1}{360}$  of a right angle. An arc of  $1^\circ$  is  $\frac{1}{360}$  of a whole circle. Because longitude and latitude lines are circles, they are also measured in degrees. Degrees in geometry are divided into 60 units called *minutes*. A minute is divided into 60 seconds. Some branches of mathematics, such as trigonometry, also measure angles in units called *radians*. See **Angle**; **Circle**; **Latitude**; **Longitude**; **Minute**; **Radian**; **Second**.

Degrees are also units of measurement of temperature. One degree of temperature on the Celsius scale is

$\frac{1}{100}$  of the difference between the temperatures of melting ice and boiling water. See **Thermometer**.

**Degree, University and college.** A university or college awards a *degree* to a person who has completed a required course of study. The institution presents the degree in the form of a *diploma*, a document which certifies the award. The basic kinds of degrees are called *bachelor*, *master*, and *doctor*. An honorary degree may be awarded for an outstanding contribution in a certain field.

Most students wishing to take a degree course seek entrance to a university. In some countries, students can take degree courses as external students, through correspondence and television courses. Britain's Open University, for example, awards its degrees to adult students.

Most universities require a good pass in the final secondary school examination, and competition is keen for entry into such faculties as medicine and law. If possible, a student planning to study in a university should seek information two years before completing a secondary school course. This will permit choice of subjects appropriate for the intended course.

**First degrees.** In English-speaking countries, first degrees are generally called *bachelor's degrees*. They include the *Bachelor of Arts (BA)* and the *Bachelor of Science (BSc)*. The BA is given for such subjects as history, literature, and fine arts, and, in some universities, for science. The BSc is given for science, engineering, and economics. Law students receive the *Bachelor of Laws (LLB)* in some universities, and the BA in others.

Until the late 1950's, students could take only two main types of course: a *general*, or *pass*, course, or a *special*, or *honours*, course. Many universities still offer such courses, which last for three years. Students following the general course take three or four related subjects. Those taking the special course generally study one subject. The general courses were designed for students who wished to have a general knowledge of a group of related subjects, such as science. The special courses were intended for those who wished to specialize in a specific subject, such as chemistry.

Some newer universities have tried to avoid the rather narrow training provided by the special courses. They plan their studies so that all students follow the same broad course in the first year, and then study at least one science and one arts subject for another three years. Students do not specialize until the second year at the earliest. They may also study both scientific and non-scientific subjects, because the division into *faculties*, common in many universities, has been abandoned.

In non-English-speaking countries, there is no standard name for a first degree. In France, the first degree is called the *licencié ès lettres*. In Germany, it is called the *staatsexamen*. In Sweden, it is called the *filosofie kandidatexamen (FK)*. The Italian *Laurea* takes the place of first and second degrees in other countries. In Japan, the bachelor's degree is called *gakushi*. It is awarded after four years of study. In the Soviet Union, students receive a diploma after studying for four or five years. The Candidate of Science (*kandidat nauk*) degree in the U.S.S.R. is equivalent to a PhD.

**Graduation.** When the student has passed a final examination, he or she is qualified to receive a degree. But



students cannot use the letters BA, BSc, and so on, until they have been formally admitted to the degree. This process is called *graduation*, and at a university or similar institution it is a dignified ceremony. For many students, a first degree marks the end of their university education. In Scotland, the MA is a first degree. A student proceeds directly to the master's degree without taking a bachelor's degree.

**Higher degrees.** In most universities, students must complete one or two years of advanced study beyond the first degree to obtain a second or higher degree. Many universities require a *thesis*, a written report of a special investigation in the student's main subject of study. In most English-speaking universities, second degrees are called *master's degrees*. Such degrees include the *Master of Arts (MA)*, *Master of Economics (MEcon)*, and *Master of Science (MSc)*.

**Doctorates.** The doctor's degree is the highest earned degree in many countries. There are two distinct types of doctor's degrees. One is a professional degree required to practise in certain professions, such as medicine. The other is a research degree that indicates the candidate has acquired mastery of a broad field of knowledge and the technique of scholarly research.

The research doctorate may require at least two or three additional years of study beyond the master's degree. The candidate may be required to complete examinations and present a written thesis or *dissertation*. The doctoral thesis represents an original contribution to knowledge, and is a more detailed study of a research problem than that required for the master's degree.

In many English-speaking universities, the *Doctor of Philosophy (PhD)* degree is the most important research doctorate and may include specialization in almost any academic subject. In some European countries, students of non-professional subjects also take a doctor's degree as the second degree. For example, the German degree of *Doctor of Philosophy (DPhil)* is the equivalent of the MA in English-speaking countries. In Russia, the Doctor

of Science (*doctor nauk*) degree is awarded by a special commission. To receive this degree, post-graduate students must research new and important material. In Japan the doctorate degree is called *nakushi*.

**Honorary degrees.** Many universities have adopted the custom of awarding honorary degrees to persons for achievement in their chosen fields. Chief among these are the *Doctor of Letters (DLitt)* and the *Doctor of Laws (LLD)*. These are often given to prominent authors, scholars, and leaders in the professions, business, government, and industry.

**History.** University degrees date from the 1200's when schools in Europe won the right to examine and license their graduates. The system of degrees, which was established by the 1300's, was modelled on the guild system. A student spent a sort of apprenticeship as a candidate for a first degree. Receiving the degree resembled becoming a journeyman in a craft. The second degree represented the status of a master craftsman, and served as a licence to teach. The student submitted a thesis as his "masterpiece," just as a journeyman submitted an example of his work to become a master craftsman. If the student continued to study and teach in law, medicine, or theology, he might earn the title of doctor. The medieval system remained largely unchanged until the 1800's. Women were excluded from obtaining university degrees until the late 1800's.

See also *Graduation*; *University*.

**De Groot, Francis Edward** (1888-1969), was a member of the Australian right wing group called the *New Guard*. This group opposed the radical premier of New South Wales, J. T. Lang, in the early 1930's.

De Groot achieved notoriety at the opening of the Sydney Harbour Bridge on March 19, 1932. Mounted, and dressed in an officer's uniform, De Groot preceded Lang in cutting the opening ribbon.

He shouted: "In the name of the loyal and decent citizens of New South Wales, I declare this bridge open." He was dragged from his horse and placed in a recep-

### Some common abbreviations for university degrees

#### First degrees

BA	Bachelor of Arts
BSc	Bachelor of Science
MA (Scottish universities)	Master of Arts
BAgr	Bachelor of Agriculture
BArch	Bachelor of Architecture
BCom	Bachelor of Commerce
BD (some universities)	Bachelor of Divinity
BEd	Bachelor of Education
BEng	Bachelor of Engineering
LLB	Bachelor of Laws
BJur	Bachelor of Jurisprudence
BMet	Bachelor of Metallurgy
BMus	Bachelor of Music
BSocSc	Bachelor of Social Sciences
BScTech	Bachelor of Technology
MB	Bachelor of Medicine
BDS	Bachelor of Dental Surgery
BVSc	Bachelor of Veterinary Science
BPharm	Bachelor of Pharmacy
ChB	Bachelor of Surgery
BChD	Bachelor of Dental Surgery
BAO	Bachelor of Obstetrics

#### Higher degrees

BCL	Bachelor of Civil Law
BD (most universities)	Bachelor of Divinity

BLitt	Bachelor of Letters
BPhil	Bachelor of Philosophy
BSc (Oxford)	Bachelor of Science
MA (except Scottish universities)	Master of Arts
MCh	Master of Surgery
MCL	Master of Civil Law
MDS	Master of Dental Surgery
MEcon	Master of Economics
Med	Master of Education
MEng	Master of Engineering
MLitt	Master of Letters
MMus	Master of Music
MSc	Master of Science
PhD or DPhil	Doctor of Philosophy

#### Senior doctorates

DCL	Doctor of Civil Law
DD	Doctor of Divinity
DT	Doctor of Theology
DLitt	Doctor of Letters
DMus	Doctor of Music
MD or DM	Doctor of Medicine
DSc	Doctor of Science
LLD	Doctor of Laws



tion house. He was later fined for offensive behaviour.

De Groot was born in Dublin, Ireland. He first arrived in Sydney in 1910. He served overseas in World War I as a captain in the Irish Hussars.

**De Groot, Huig.** See Grotius, Hugo.

**De Havilland, Sir Geoffrey** (1882-1965), was a noted British aircraft designer and manufacturer. He built his first aeroplane in 1908—only five years after the first successful flight. During World War I, De Havilland designed several successful types of fighter and bomber aircraft, such as the D. H. 4. In 1920, he formed his own aircraft company, which later produced such famous aeroplanes as the *Moth* biplane; the *Mosquito* fighter bomber; and the *Comet*, the world's first jet airliner. De Havilland was awarded several medals for his outstanding services to aviation. He was born near Colchester, in Essex.

**De Hooch, Pieter** (1629-1684?), was a Dutch painter noted for his charming scenes of middle-class life. His style is distinguished by warm, often unmixed colours and the skilful portrayal of the effects of sunlight. Like other Dutch painters of his time, de Hooch experimented with showing depth and the illusion of space. Unlike earlier Dutch painters of everyday life, he often included glimpses through the open doors or windows into rooms, streets, or gardens. De Hooch and Jan Vermeer, another Dutch painter of the 1600's, probably influenced each other. De Hooch was born in Rotterdam. He joined the Guild of Painters in Delft in 1655.

**Dehumidifier** is a device that removes moisture from the air. Dehumidifiers are commonly used to make homes more comfortable.

The amount of moisture the air can contain is related to the temperature of the air. The warmer the air is, the more moisture it can hold. On hot summer days, that moisture can greatly increase the discomfort people feel. When the moisture level of the air is reduced, however, moisture from the skin evaporates more readily. As a result, people feel cooler—even though the temperature of the air remains the same.

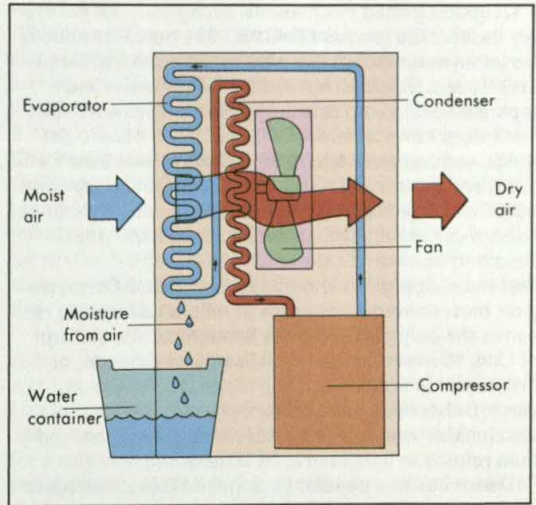
A dehumidifier consists of a set of cold coils, called the *evaporator*, and a set of hot coils, called the *condenser*. A fan in the dehumidifier draws moisture-filled air from a room and blows it across the coils. The air loses moisture as it passes over the evaporator and it is reheated to room temperature by the condenser. The air then reenters the room, absorbs moisture again, and recirculates through the dehumidifier. The moisture the air loses is carried by a hose from the dehumidifier to a drain or sink, or it is collected in a built-in container.

See also **Air conditioning** (Controlling the moisture); **Humidifier**; **Humidity**.

**Dehydrated food** is food that has been preserved by drying. Adding water to such food makes it ready for eating or for cooking. Dried milk and milk products, soups, coffee, tea, spices, gelatin, dessert mixes, and macaroni are sold in many shops. Other common dehydrated foods include yeast, cheese, and egg products.

Important features of dehydrated foods are their lightness in weight and their compactness. More than 90 per cent of the water is removed during drying. When adequately packaged, most dehydrated foods can be kept for several months if stored below 24° C.

Foods selected for drying must be fresh, clean, and at



**A dehumidifier** removes moisture from the air. The fan draws in moist air, which loses its moisture as it passes over the evaporator. The air is reheated by the condenser, and then released.

the proper stage of ripeness. Vegetables are usually *blanched* (briefly heated and cooled) to destroy enzymes before drying. Biological products such as serums and vaccines and such foods as chickens and mushrooms are freeze-dried. In the freeze-drying process, the product is frozen and held under conditions of low heat and a nearly perfect vacuum. As a result, the ice in the frozen food is vaporized without melting.

See also **Food preservation** (Drying).

**Dehydration** is a condition characterized by the excessive loss of water from the body. In most cases of dehydration, water loss is accompanied by a loss of salt from the body. Symptoms of mild dehydration include dryness of the mucous membranes of the nose, mouth, and throat; reduced ability to sweat and urinate; and doughy skin. In severe dehydration, rapid loss of salt and water leads to fast heartbeat, low blood pressure, shock, and even death.

Worldwide, the most common cause of dehydration is infectious diarrhoea. Dehydration resulting from diarrhoea is a major cause of death in children in developing countries. Other causes of dehydration include vomiting, excessive sweating or urination, and extensive skin burns. Extended shortages of water may also produce dehydration in individuals. In addition, dehydration sometimes occurs in people in prolonged comas. Such people may become dehydrated because they are unable to respond to thirst.

People suffering from mild dehydration should drink plenty of fluids. Cases of severe dehydration usually require hospitalization. In treating diarrhoea-related dehydration, doctors use a solution containing glucose to restore lost water and salt. This solution may be taken orally or by injection.

**Deighton, Len** (1929- ), is an English author known for espionage and war novels. He belongs to the antiromantic school of spy novelists, presenting espionage as an unglamorous and ruthless activity.



Deighton gained international recognition for his first spy thriller, *The Ipcress File* (1962). The novel introduces the anonymous British spy who narrates most of Deighton's novels. Deighton has written two trilogies and a separate novel about British spy Bernard Samson. The first trilogy consists of *Berlin Game* (1983), *Mexico Set* (1985), and *London Match* (1985). Next came *Winter* (1987) and the second trilogy, *Spy Hook* (1988), *Spy Line* (1989), and *Spy Sink* (1990). His other novels include *Funeral in Berlin* (1964), *SS-GB* (1978), and *XPD* (1981). Deighton was born in London.

**Deism** is a religious and philosophic belief. Deism rejects most conventional forms of religion, accepting reason as the only guide to truth. It embraces the concept of God, however, in the limited sense of a creator, or first cause, of the physical and moral laws of the universe. Deists compare God's act of creation to that of a watchmaker who builds a watch, sets it in motion, and then refuses to intervene in its actions.

Deism became popular during the 1700's. Deist ideas appear in the writings of such philosophers as Jean Jacques Rousseau and Voltaire of France and Immanuel Kant of Germany. The deist concept of God underlies such phrases as "In God We Trust" and "we are endowed by the Creator with certain inalienable rights."

See also **Atheism; God; Theism**.

**DeJong, Meindert** (1906- ), is an author of children's books. His best-known works include *The Wheel on the School* (1954) and *Journey from Peppermint Street* (1968).

DeJong was born in Wierum, the Netherlands, and went to the United States at the age of eight. In 1962, DeJong was awarded the Hans Christian Andersen Medal.

**Dekker, Thomas** (1572?-1632?), brought to Elizabethan popular literature a fresh emphasis on the life of his day. Dekker's best-known play is *The Shoemaker's Holiday* (1599). It is a zestful picture of English life that combines patriotism and romance with a favourable portrayal of the merchant and artisan classes. Dekker's other plays include the romance *Old Fortunatus* (1599) and the comedy *The Honest Whore* (1604-1605).

Dekker wrote many dramas and pamphlets. Between 1598 and 1602 alone, he wrote all or part of over 40 plays, most of them now lost. Yet he usually had no money and apparently spent several years in prison for debt. From about 1604, Dekker wrote popular pamphlets, mainly satires of the London underworld.

**De Klerk, F. W.** (1936- ) was state president of South Africa from 1989 to 1994. During his term of office, he played a major role in ending South Africa's policy of enforced ethnic segregation called *apartheid*. In 1994, de Klerk's National Party lost power in South Africa's first democratic general election. De Klerk then became second deputy president in the new Government of National Unity headed by Nelson Mandela.

Frederik Willem de Klerk was born in Johan-



Frederik W. de Klerk

nesburg. He attended Potchefstroom University in what is now North West Province. In 1961, he began practising as a lawyer. De Klerk first won election to parliament as National Party member for Vereeniging in 1972. In 1978, he became a member of Prime Minister P. W. Botha's Cabinet. (Botha later became president under the terms of a new Constitution adopted in 1984.) In August 1989, de Klerk led a National Party delegation which forced the resignation of Botha, who had suffered a stroke. De Klerk was elected president later that year.

In 1990, de Klerk ended the government's 30-year ban on the African National Congress (ANC) and other anti-apartheid groups. He released Nelson Mandela and other ANC leaders from prison and entered negotiations toward a new democratic future for South Africa. De Klerk and Mandela were joint winners of the 1993 Nobel Prize for peace. The Nobel committee cited the "personal integrity and great political courage" of the two leaders in negotiating South Africa's transition to democracy.

See also **Mandela, Nelson; South Africa, History of**.  
**De Kooning, Willem** (1904- ), is a leading abstract expressionist artist. He is best known for his hectic and violent paintings dominated by lunging brushstrokes, swirling paint patterns, and a strong emphasis on line. In later works, De Kooning simplified his paintings, sometimes working with purely linear patterns on clear, white canvas. But the mood of De Kooning's paintings and drawings is not always explosive. In his early tender portraits, his studies of women in the 1960's, and other works, he has shown impressive skill with refined, delicate compositions and colours.



Oil painting and newspaper on canvas (1956); Metropolitan Museum of Art, New York City

A Willem De Kooning painting called *Easter Monday* is typical of the abstract style he developed in the mid-1950's. This style featured short, broken brushstrokes and bright colours.



De Kooning was born in Rotterdam, the Netherlands, and moved to the United States in 1926. He gained his first critical acclaim for his abstract paintings of the late 1940's. Painted largely in black and white enamel, these pictures are composed of rhythmic curved lines mixed with oddly shaped flat planes. In 1953, De Kooning exhibited a series of oils and pastels titled *Woman* in which he appeared to present a savage vision of woman as siren or dark goddess. The exhibition inspired many younger artists to seek new ways of representing the human figure. Many De Kooning paintings of the 1960's and 1970's contain landscape elements and suggest huge spaces and outdoor light.

**Delacroix, Eugène** (1798-1863), was the chief representative of the romantic style of painting in France. Like many romantics, Delacroix painted exotic, faraway, emotional subjects. His painting was influenced by Flemish painter Peter Paul Rubens' bold, thick brushstrokes and the deep, rich colours of the Venetian Renaissance painters.

As a young man, Delacroix deeply admired such English writers as William Shakespeare and Lord Byron, whose work provided subjects for his paintings. His sympathy for the Greeks' struggle for independence from Turkey inspired him to paint *Incidents from the Massacre at Chios* (1824). In 1830, he participated in the revolution in Paris. His painting *Liberty Leading the People* (1830) glorifies this event.

In 1832, Delacroix travelled to North Africa, where the effects of the intense sunlight led to his use of shimmering colour highlights. The sketches of exotic people, animals, and events he made in Africa became subjects for many of his later paintings, starting with *The Women of Algiers* (1834). Ferdinand Victor Eugène Delacroix was born at Charenton, near Paris.

For examples of Delacroix's paintings see **Columbus, Christopher**; **Greece; Painting** (The 1800's; picture: *Jewish Wedding in Morocco*).

**De la Cruz, Apolinario** (1814-1841), was a Filipino religious leader who tried to provide native-born Filipinos with a means of entering a career in the Roman Catholic Church. By doing so, he opposed the Spanish rulers of the Philippines. As a young man, he went to Manila to become a Roman Catholic priest, but no Roman Catholic order would accept a native Filipino. He therefore founded his own order at Lucban, Tayabas (now Quezon Province). This order, the Confraternity of Saint Joseph, accepted only native Filipinos.

The Confraternity attracted up to 5,000 members. The Spaniards suspected that it was a secret political organization set to overthrow the state. In November 1841, Spanish soldiers attacked de la Cruz and his followers, killing a thousand of them. They arrested de la Cruz, tried him for treason, and executed him. De la Cruz was born in Lucban of well-to-do and devout Roman Catholic parents.

**De La Mare, Walter** (1873-1956), was an English author noted for his romantic works for both adults and children. He wrote poems, short stories, novels, and plays distinguished by a unique mixture of dreams, reality, and the supernatural.

De La Mare also edited books for children. His anthology of prose and verse called *Come Hither* (1923) is a children's classic. De La Mare's best collections of po-

etry include *Peacock Pie* (1913) and *Bells and Grass* (1942). His most popular short stories were published in *Collected Stories for Children* (1947). Perhaps his best-known work for adults is the novel *Memoirs of a Midget* (1921). It is a romantic fantasy about society as seen through the eyes of a midget. De La Mare was born in Charlton, near London.

**Delane, John Thaddeus** (1817-1879), was a British journalist whose writings on political matters had much influence on government policy during his time. As editor of *The Times*, a post he held for 36 years, Delane strongly criticized the government for its negligence in the Crimean War.

In 1864, Delane prevented the government from assisting Denmark against the attacks of Prussia. Delane was born in London. He was educated at King's College, London, and at Oxford University. John Walter, owner of *The Times*, was a friend of his family and picked him out for a career in journalism.

**Delaware** (pop. 668,696) is one of the smallest states in the United States. It lies in the northeastern corner of the U.S. Southern States and covers an area of 5,295 square kilometres. Wilmington, Delaware's only large city, is an important chemical industry centre. Dover is the state's capital. The state's business and tax laws favour corporations—even those that do most of their business outside of Delaware. For this reason, more



**Delaware** lies along the Atlantic Coastline. It has low, flat, coastal plains to the south and rolling hills to the north.

than 170,000 companies, including many of the largest U.S. firms, are incorporated in Delaware.

The Delaware River links northern Delaware with Delaware Bay and the Atlantic Ocean. A long sand reef along the Atlantic coast is a popular holiday area.

Algonquian Indians lived in Delaware before Europeans arrived in the region. The English explorer Henry Hudson visited Delaware in 1609. In 1610, Captain Samuel Argall of Virginia named Delaware Bay after Virginia's governor, Lord De La Warr. During the American Civil War (1861-1865), Delaware fought on the Union side. The state adopted its constitution in 1889.

**Delbrück, Max.** See **Nobel Prizes** (table: Nobel Prizes for physiology or medicine—1969).

**Del Cano, Juan Sebastian.** See **Magellan, Ferdinand** (The end of the voyage).

**De León, Juan Ponce.** See **Ponce de León, Juan.**



**Delft** is a type of earthenware that was made in the late 1500's and flourished into the mid-1700's. It is named after the town of Delft in the Netherlands, a centre of production. About the same time, potters in England made a similar pottery which they also called delft. Delft was glazed with tin oxide to produce a creamy white surface. Designs were painted with other metallic oxides that turned various colours when the pottery was fired (baked).

Delft closely resembles two other kinds of pottery called *faïence* and *majolica*. The three differ only in the style of their decoration. See **Faïence**; **Majolica**.

Delft of the early 1600's imitated Chinese porcelain. By the 1700's, potters had adopted European stylistic characteristics and subject matter. Dutch delft often shows historical events,

landscapes, or scenes of daily life. Much English delft is decorated with simple mottoes or portraits of monarchs. Some delft is still produced today.

**Delhi** is an Indian union territory. It is made up of three main census areas—Old Delhi, New Delhi, and Delhi Cantonment, including 214 villages in the surrounding countryside. The Delhi union territory has an area of 1,483 square kilometres. It has a population of 9,370,475.

Old Delhi covers 932 square kilometres. It has a population of 7,174,755.

New Delhi was built by the British 5 kilometres to the south of Old Delhi in the early 1900's. But the two cities have since merged to form a single metropolis. New Delhi is the official capital of India. It covers 439 square kilometres and has a population of 294,149.

Delhi lies on the Jumna (or Yamuna) River, a tributary of the Ganges (or Ganga), in north central India. It is about 150 kilometres south of the Himalaya. For the location of Delhi, see **India** (political map).

As it includes the nation's capital, Delhi is a union territory under the control of the central government, rather than a separate state. To the east lies the state of Uttar Pradesh, and to the north, west and south, Delhi is surrounded by the state of Haryana.

### The city

Delhi, including both Old and New Delhi, lies within a roughly three-sided area of land known as the Delhi Triangle, bounded on two sides by hills of the Aravalli range and on the third side by the Jumna. The contrast between Old and New Delhi is striking.

**Old Delhi** consists of a twisted maze of narrow winding streets cut through by a few broad roads. Living conditions in Old Delhi are overcrowded and cramped. Many industries are in these heavily populated residential parts of the city. The busiest and most colourful

street is Chandni Chowk. The name literally means "silver street". But Chandni Chowk is in fact a wide boulevard measuring 21 metres across and packed with shops and stalls and multicoloured temples. It was laid out in 1650 on the orders of the Mughal princess, Jahan Ara.

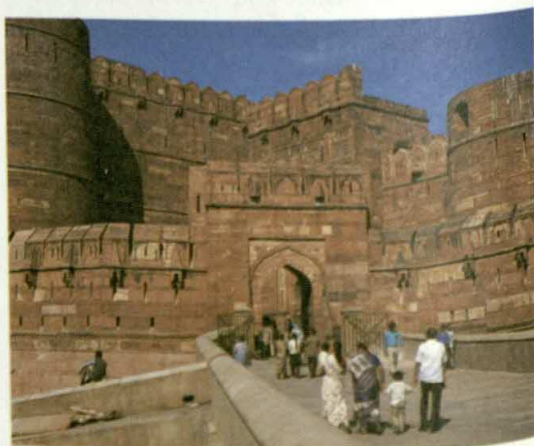
**New Delhi** was designed by the British architect Sir Edwin Lutyens, assisted by Sir Herbert Baker. It was laid out 5 kilometres south of Old Delhi on a well-drained site standing slightly above the level of the surrounding plain. The builders used explosives to blast away the top layer of the land to flatten it and provide earth to fill in the nearby valleys. The resulting complex is a spacious, attractive, and carefully planned city, with broad, tree-lined avenues and many open areas, parks, gardens, and fountains.

Many of New Delhi's best-known landmarks lie on a line running east to west through the city. The line starts at the National Stadium. Then it passes through the Children's Park and the War Memorial Arch along the impressive Raj Path, through Central Vista Park, to Rashtrapati Bhavan (the residence of the president of India). A similar line running north-south, known as "Janpath", goes from the main shopping centre, Connaught Place, to residential suburbs. Several districts retain their own character. The Civil Lines, originally laid out to house British colonial officials, is now a residential area for well-off Indian government officials. A large industrial area, Okhla, is on Mathura Marg in the south. Kotla Mubarakpur has the appearance of a sprawling country village. Chanakyapuri is an area set aside for foreign embassies. The vast sports complex, built for the 1982 Asian Games, contains a stadium that seats 30,000 people. Delhi also has India's finest zoo, with rare white tigers.

Delhi contains what are probably the finest monuments in any city in India. The Qutab Minar, one of the city's most famous sights, is a 5-storey, 72-metre tower of red sandstone. It was begun in 1199 as a symbol of Muslim victory and power and used for hundreds of years by *muezzins* (mosque officials) calling the faithful to prayer. Near the Qutab is one of Delhi's most remarkable sights, a simple pillar, set up about A.D. 400. It weighs over 6 metric tons, stands more than 7 metres



A delft vase



The Red Fort in Old Delhi, built for the Mughal emperors, attracts many visitors and impresses by its size and colour.





**Republic Day Parade** in New Delhi is held on January 26. On that day in 1950 a new constitution started, making India an independent, democratic republic. Many representative groups take part in the procession. The contingent approaching in this picture carry the red flags of the Rajputs, the landowning caste.

high and has never rusted. The citadel of Tughluqabad was a major centre of power for about ten years in the 1300's and has been a wasteland of ruins ever since. In the beautiful Lodi Gardens is the cemetery of the Lodi kings, who ruled India from Delhi during the 1400's and were overthrown by the Mughals in 1526.

Shah Jahan's *Lal Qila* (Red Fort) dates from the 1600's. Its walls of red sandstone enclose elegant halls and pavilions where the Mughal emperors held lavish ceremonies and gave audience to subjects and ambassadors. The Jama Masjid is the biggest mosque in all India and was also built by Shah Jahan.

**People.** More than 50 per cent of the inhabitants of Delhi are immigrants to the area. Four out of five residents are Hindus. Muslims are the largest minority, but there are also Jains, Christians, and Buddhists.

**Education and culture.** Delhi has three higher education complexes, the University of Delhi, the Jawaharlal Nehru University and the Jamia Millia Islamia. All three are federal universities. It is also home to the Sangeet

Natak Akademi, for the performing arts; the Lalit Kala Akademi, for painting, sculpture, architecture, and applied arts; and the Sahitya Akademi, for literature and languages. In addition, New Delhi has the National Museum and the National Gallery of Modern Art. There are also museums dedicated to Mohandas K. Gandhi, Jawaharlal Nehru, Indira Gandhi, and to the Indian Air Force, rail transport, dolls, stamps, Tibet, and natural history.

Culture and the arts flourish thanks to the variety of the population and encouragement from the government. Indian dance, drama, and music remain popular, but young people in Delhi also enjoy going to the cinema to watch both Western films and the products of India's thriving film industry.

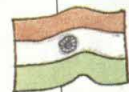
Delhi is noted for the wide variety of its cooking. Mughlai court food had consisted of rich meat and vegetable dishes in the Persian style, cooked in spices and rich cream. Visitors to Delhi can still enjoy such cooking. Other local specialities include marinated kebabs, chicken, mutton or fish cooked slowly in a *tandoor* (clay

**The city of New Delhi** was carefully planned and its wide avenues contrast with the narrow streets of Old Delhi. Specially planted trees add elegance to broad boulevards which provide plenty of space for traffic and pedestrians.

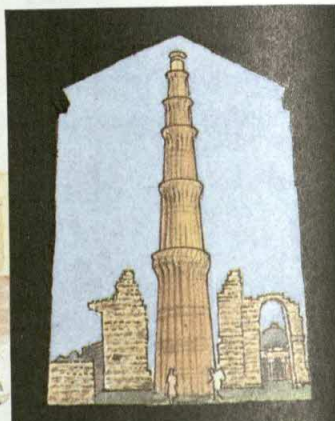




# Delhi *Capital of ancient empires: Monuments throughout the city glorify its rich history.*

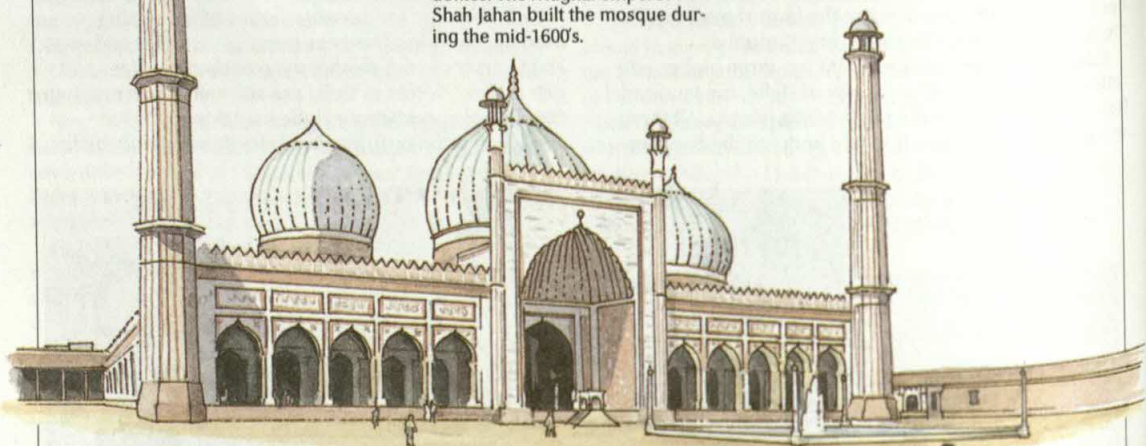


**A government building** in New Delhi, *above*, reflects the influence of the British. The English architects Sir Herbert Baker and Sir Edwin L.utyens designed and built New Delhi in the early 1900's. The new city replaced Delhi as the capital of India.



**The Qutab Minar**, *above*, is a famous stone monument. The five-tiered tower stands 72.5 metres high. It has 376 steps leading to a splendid view of the city. Sultans of Delhi built the Qutab Minar from 1199 to the 1300's.

**The Jama Masjid**, *below*, one of India's largest mosques, is known for its beauty. It is made of marble and sandstone, with three marble domes. The Mughal emperor Shah Jahan built the mosque during the mid-1600's.



**1206**

**Delhi sultanate**, a Muslim empire, was established in Delhi. Controlled large area until 1526.

**1398**

**Tamerlane** of central Asia captured and sacked Delhi. Sultans regained city.

**1526**

**Babar** defeated last sultan of Delhi; established Mughal Empire.

**1600's**

**Mughal emperors** built much of present city.

**1803**

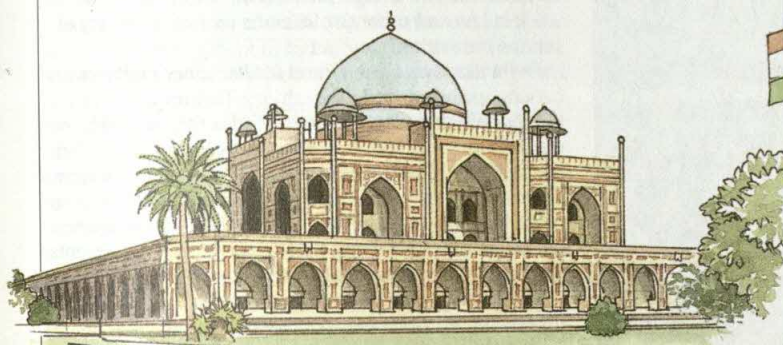
**The East India Company** of Britain took control of Delhi.

**1857**

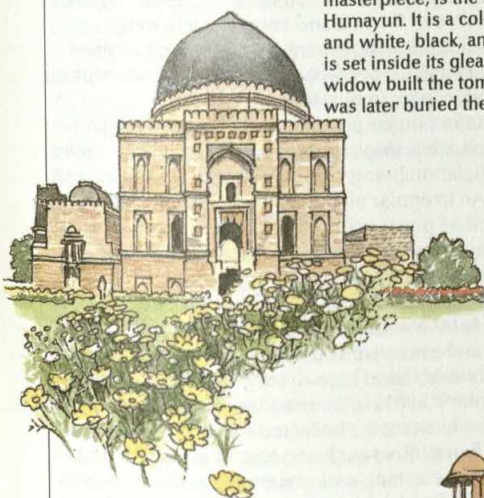
**The Indian Revolt** against East India Company broke out near Delhi.





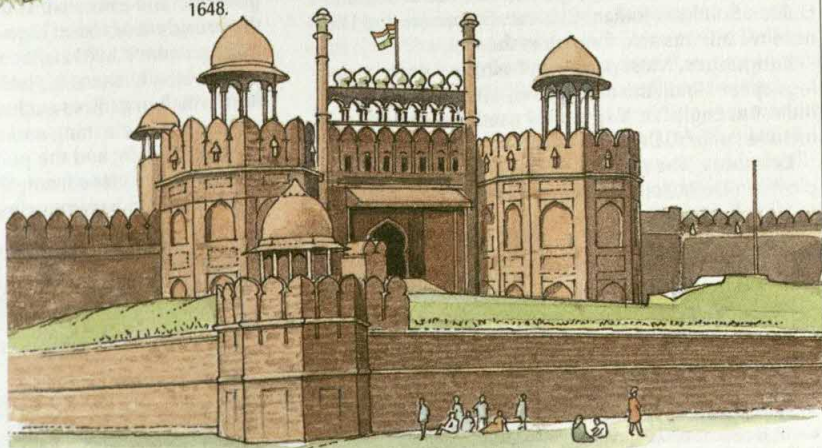


**Humayun's Tomb**, above, an architectural masterpiece, is the burial site of the Mughal emperor Humayun. It is a colourful blend of red sandstone and white, black, and red marble. An interior dome is set inside its gleaming exterior dome. Humayun's widow built the tomb in the mid-1500's. She was later buried there.



**A tomb at Lodi Gardens**, above, houses the graves of several members of the Lodi rulers of the 1400's. Beautiful gardens surround the tombs. Visitors to Lodi Gardens may stroll along winding paths through the elegant landscaping.

**The Red Fort**, below, is one of Delhi's most outstanding Mughal monuments. It is made of red sandstone, and covers several hectares. Within the walls of the fort lie the remains of the imperial palace and other Mughal structures. Emperor Shah Jahan built the Red Fort between 1639 and 1648.



Lies on western bank of Jumna River in northern India. Country's second largest city after Bombay. Delhi metropolitan area pop.: 8,375,188.

Important centre of manufacturing. Major products include car parts, electrical products, handcrafted jewellery, and fabrics.

Since ancient times, Delhi area has been site of many cities. Today, city is old and crowded: narrow streets and run-down areas contrast with wide boulevards and modern buildings of New Delhi. Chandni Chowk, Delhi's busiest street, is lined with tiny craft shops.

**1912**  
British government moved national capital from Calcutta to Delhi.

**1947**  
India won independence from Britain. Delhi's population began to grow rapidly.

**1950**  
India's constitution went into effect on Jan. 26. Huge celebration occurs annually in New Delhi.



**1931**  
New Delhi replaced Delhi as capital.

**1948**  
The great leader Mohandas Gandhi was assassinated in New Delhi.

**1987**  
Bahai temple dedicated in New Delhi after its completion in 1986.





**A view across Delhi** shows striking contrasts between old and new in architecture and layout.

oven) and *chack*, a refreshing drink made of thin yoghurt flavoured with ginger, cumin, coriander, and chillies. Southern Indian, Chinese, European, and Lebanese restaurants also flourish in the city.

**Languages.** Most people in Delhi and its surroundings speak Hindi, the most widely-spoken language in India. But English is also widely used. Other languages include Punjabi, Urdu, and Bengali.

**Economy.** The government itself is the largest employer in Delhi, followed by industry, and then com-

merce. A large number of people work in the Indian Civil Service and Delhi's local administration. Others work in law and other professions or a wide variety of service industries.

Delhi has long been famed for its luxury crafts—ivory carving, painting, and embroidery. This tradition of highly skilled work now also includes the manufacture of machine tools and precision instruments. Delhi also has India's largest concentration of electronics factories. Companies in the city manufacture radio and television parts. Plants in Delhi produce chemicals and fertilizers. Other major industries include the making of garments, leather goods, and sporting equipment.

Old-fashioned handicrafts still survive, supported in part by the tourist trade. Weavers, jewellers, and goldsmiths still work in Old Delhi. Craftworkers in wood, brass, and terracotta, display their skills at the city's Crafts Museum.

Delhi's geographical and political importance make it a major centre of finance and commerce in India. Wholesale and distributive trades are among its chief activities. It has also become the focus of India's banking system and insurance business.

Delhi suffers major problems that hamper its economy. One is a housing shortage, which results in a third of the population being crammed into slums and illegal shanties. An irregular electrical power supply forces factories to close down production without warning. Hard-pressed water and sewerage services struggle to keep up with the requirements of the city.

**Government.** Delhi has a complicated three-level system of local administration. At the top is a lieutenant governor and executive council of four, all appointed by the president of India. Then there is an elected metropolitan council, which discusses issues but has no direct power. Finally, there is an elected municipal corporation, which organizes such services as electricity and water supply, cleaning and sewerage, public transport, the fire brigade, and the police.

Delhi is the place from which the whole of India is governed, and has imposing government buildings. The

**An aerial view of Parliament House (Sansad Bhavan)** in New Delhi shows the geometrical symmetry used by the British architects when designing these government buildings and planning their spacious layout. In the top right-hand corner can be seen part of the Central Secretariat building.





most impressive building is the huge *Rashtrapati Bhavan* (Presidential House). Designed by Lutyens as a home for the viceroy of India, it is now the official residence of the president of India. Nearby stands the *Sansad Bhavan* (Parliament House), designed by Sir Herbert Baker. Its three semi-circular halls were originally intended to house the Chamber of Princes, Council of State, and Legislative Assembly. They now contain the upper house, *Rajya Sabha* (Council of the States), the lower house, *Lok Sabha* (House of the People), and a magnificent library.

**Transport and communication.** All land routes from northwest India to the eastern plain pass through the Delhi area. This makes it the hub of the country's transport system, where five national highways and several railway lines converge. Indira Gandhi International Airport, to the southwest of the main city, is a stopover in the international airway system. The airport has boosted the city's tourist trade. Palam Airport is used for domestic flights.

India's leading newspapers all have their head offices in Delhi. They are *The Times of India*, *The Statesman*, *The Hindustan Times*, and *The Indian Express*. All-India Radio, the state radio service, has studios in Delhi. Many of the state-run television programmes also originate from the Indian capital.

### History

There is a reference to a settlement called *Indraprastha* in the great epic poem *Mahabharata*. Archaeologists believe that this settlement was located in the Delhi area at the village of Indapat. Excavations in the Old Fort have revealed that a settlement existed there before 2000 B.C. and that people lived there continuously until about A.D. 1000. In the 1100's, Prithviraja III of the Chauhan dynasty made Delhi his capital, only to be displaced by the Muslim conqueror Qutb-ud-Din Aibak. The city was the first of at least seven to be built in the Delhi Triangle.

Successive Turkish and Afghan dynasties built cities on different sites in the Delhi area between 1193 and 1354. The devastating invasion of Tamerlane in 1389-1398 caused the capital to be shifted to Agra. But Babur, founder of the Mughal dynasty and empire, shifted the capital back to Delhi in 1526. His son, Humayun, built another city, which was destroyed in 1540 by the invader Sher Shah.



A school in Delhi is a fine example of the city's modern, functional buildings.

The Mughal emperor Akbar kept court at Fatehpur Sikri. His successor, Jahangir, was based in Agra. But in 1638 Shah Jahan commenced the building of the seventh city—Shahjahanabad—now known as Old Delhi. The city once more became the capital. Later, as Mughal power weakened, Delhi was repeatedly raided and robbed of its treasures. The most terrible attack was the invasion of the Persian Nadir Shah in 1739. The British took possession of the city in 1803 but did not immediately make it their capital. Calcutta, the gateway to the earliest British conquests, remained the capital of British India.

During the Indian Revolt of 1857, Indian soldiers held Delhi for five months. The British recapture of the city involved fierce fighting and much destruction. In 1877, the British authorities announced at Delhi the proclamation of Queen Victoria as empress of India.

In 1911, Delhi was the setting for a glittering spectacle called a *durbār*, or royal gathering, at which the 562 princes of India met to pay their respects to George V, the only king-emperor ever to visit the country. The royal visitor chose the occasion to announce that the capital was to move from Calcutta to Delhi. The formal move took place in 1912. In the same year, work began on planning and building New Delhi to house the new seat of government.

New Delhi was intended to be the British imperial equivalent of Rome, imposing, and capable of expanding to something even greater. About 30,000 labourers were needed just to put up the official buildings and plant 10,000 trees. When India became independent in 1947, New Delhi became its capital.

See also *India; India, History of; New Delhi*.



Mohandas Gandhi's memorial in Delhi is at Raj Ghat on the west bank of the Jumna River.



**Delhi Sultanate** was a Muslim empire that controlled much of what is now Bangladesh, India, and Pakistan from 1206 to 1526. The sultanate's boundaries shifted, depending on its military strength, but it centred in the Ganges Valley and Punjab. Delhi was the capital. The sultans brought much of India under Muslim rule. Trade routes opened and commerce flourished.

In the late 1100's, Muhammad of Ghor, a Turkish Muslim king, seized much of northern India. In 1206, a sultanate was established at Delhi. During the 1200's, the sultans successfully defended their territory from the remaining Hindu and Buddhist kings. They also prevented the Mongols, who had already conquered China and the Middle East, from conquering India.

During the 1300's, the sultanate temporarily extended its power far into southern India. In 1398, the conqueror Tamerlane looted and destroyed Delhi and massacred most of its people. Although the sultans regained Delhi after Tamerlane left that same year, their former territory was split into regional kingdoms. Babar, a descendant of Tamerlane, defeated the last sultan in 1526 and established the Mughal Empire.

During the sultanate, many Muslims migrated to India to serve as soldiers, government officials, priests, or merchants. Muslim holy men converted many Indians to Islam, the religion of the Muslims. Other Indians switched religions to improve their economic position. Most of the converts lived in the northwest and northeast, now Pakistan and Bangladesh.

**Delhi Union Territory.** See Delhi.

**Delibes, Léo** (1836-1891), was a French composer. During his lifetime, he was best known for his light operas. Today, his reputation rests on three works—the ballets *Coppélia* (1870) and *Sylvia* (1876) and the opera *Lakmé* (1883). Music from both ballets has been adapted into popular orchestral suites. *Lakmé* contains the famous "Bell Song," an aria for coloratura soprano. The three compositions reflect Delibes's brilliant orchestral writing, rhythmic subtlety, and easily remembered melodies. His other works include music for an 1882 revival of Victor Hugo's play *Le Roi s'amuse* and a collection of 15 songs, published in 1885 or 1886. The collection includes the popular "The Girls of Cadiz."

Delibes was born in St. Germain du Val, near Le Mans. His full name was Clément Philibert Léo Delibes. He studied composition at the Paris Conservatory from 1848 to 1852 and composed his first work, an operetta, in 1855. Delibes also worked as an organist for several years. He became a professor of composition at the Paris Conservatory in 1881.

**Delilah**, in the Old Testament, was the Philistine mistress of Samson, the Israelite folk hero famed for his tremendous strength. The Philistines, enemies of the Israelites, bribed Delilah to find out the secret of Samson's power so that they could take him prisoner. After much coaxing, Samson told Delilah that his strength lay in his long, thick hair which, because of a vow, he had never cut. Delilah had his head shaved while he was asleep. He became weak and helpless. The Philistines easily captured him, blinded him, and made him work as a slave. The story of Samson is told in Judges 16.

**Delinquency, Juvenile.** See Juvenile delinquency.

**Delirium tremens**, often called the *DTs*, is a nervous and mental disturbance that results from acute alco-



Luca Della Robbia created *Madonna and Child Jesus*.

holism. Many people become markedly disturbed and develop delirium tremens after unusually prolonged or heavy drinking of alcoholic beverages. They develop insomnia and a dislike for food, and become irritable and restless. They may then have visual illusions and hallucinations that are brief but terrifying. The condition itself may last from 3 to 10 days. Death sometimes results, often because pneumonia or heart failure develops. Doctors usually treat delirium tremens by taking alcohol away from patients and giving them sedative and tranquillizing drugs. See also *Alcoholism*.

**Delius, Frederick** (1862-1934), was an English composer. He wrote in many forms but is best known for compositions that combine chorus, vocal soloists, and orchestra. These works include *Sea Drift* (1906), based on the poetry of the American poet Walt Whitman; and *A Mass of Life* (1908-1909), based on texts by the German philosopher Friedrich Nietzsche. Delius also composed chamber music, concertos, operas, songs, symphonic tone poems, and incidental music for plays. His finest music generates emotional power by blending simple melodies with rich and subtle harmonies.

Frederick Theodore Albert Delius was born in Bradford. From 1884 to 1888, he lived in Florida, in the United States, where he was influenced by black folk music. In his mature style, he combined this influence with elements from such European composers as Claude Debussy, Edvard Grieg, and Richard Wagner.

**Della Francesca, Piero.** See Piero della Francesca.

**Della Robbia, Andrea.** See Della Robbia, Luca.



**Della Robbia, Luca** (1399?-1482), was an Italian sculptor of the early Renaissance. Della Robbia created works in bronze and marble, but he is best known for his sculpture in terracotta, which is a type of hard, durable earthenware. Della Robbia covered his terracottas with glazes of bright colours, usually white against a blue background. These glazed terracottas were less expensive to make than marble and they were also more durable than paint.

The first work known to be by della Robbia—and one of his most famous—is the *Cantoria*, or *Singing Gallery* (1431-1438). The *Cantoria* consists of 10 panels that portray children in relief sculpture singing and playing musical instruments. The panels are framed by delicately carved neoclassical architecture. The work illustrates the Biblical text of Psalm 150. The *Cantoria* was originally located over a doorway in the Cathedral of Florence and is now in the Cathedral museum. A detail of the *Cantoria* appears in *Classical music* (Highlights in the history of classical music). Della Robbia was born in Florence.

Luca della Robbia's nephew, Andrea della Robbia, was a pupil of his uncle and inherited the family workshop in Florence. Five of Andrea della Robbia's sons were trained in the della Robbia workshop and became recognized sculptors.

**Deller, Alfred** (1912-1979), was a leading English countertenor. He sang at many European music festivals and made a large number of gramophone recordings. Deller specialized in music of the 1600's and 1700's. He formed a vocal ensemble, *The Deller Consort*, in 1950. Deller was born at Margate, England. He sang as a boy treble in the choir of his local church. When his voice matured into a natural countertenor, he could find no expert tuition. He had to teach himself.

**Dells.** See Dalles.

**Delors, Jacques** (1925- ), a French politician, was president of the European Commission from 1985 to 1994. He increased the influence of the commission as the executive branch of the European Community (now the European Union) and pressed for its political and economic union.

Jacques Lucien Jean Delors was born in Paris. He studied economics at the University of Paris. He worked at the Bank of France from 1945 to 1962. A member of the Socialist Party, he was adviser to Prime Minister Jacques Chabrin-Delmas from 1969 to 1972. From 1981 to 1984, Delors was minister for economy and finance.

**De los Angeles, Victoria** (1923- ), a Spanish lyric soprano, won international acclaim as an opera singer, a recitalist, and an orchestral soloist. She became famous for her performances in such operatic roles as Mimi in *La Bohème* and Manon in *Manon*. Critics consider her one of the finest performers of French songs and a distinguished interpreter of Spanish folk songs.

Victoria de los Angeles López García was born in Barcelona and studied at the Barcelona Conservatory. She made her operatic debut in Barcelona in 1945, and her Metropolitan Opera debut in 1951.

**Delphi** was a town situated on the southern slope of Mount Parnassus. The town had the oldest and most influential religious sanctuary in ancient Greece. It was in the district of Phocis.

The ancient Greeks believed that the site of Delphi was sacred to the god Apollo. It gained importance as

early as the 1100's B.C. Later, the site of Delphi became an international Greek shrine. The sanctuary of Delphi contained the main temple of Apollo, a stadium, a theatre, and many small buildings and monuments.

The temple contained the famous *oracle*, or prophet (see *Oracle*). A woman oracle, called Pythia, would utter strange sounds while in a frenzy. People believed these were the words of Apollo (see *Apollo*). Cities, as well as private individuals, sought her advice. As a result, the oracle greatly influenced Greek religion, economics, and politics. This influence gradually waned in later Greek and Roman times.

**Delphinium.** See Larkspur; Flower (picture: Garden perennials).

**Delta** is a low plain composed of clay, gravel, sand, and other sediments deposited at the mouth of a river. Deltas are named after the Greek letter *delta* ( $\Delta$ ) because many are roughly triangular. They form when rivers flow into bodies of standing water, where their speed and ability to carry sediments are suddenly reduced.

The chief factors that affect the formation of deltas include climate, geological features, river size and flooding patterns, and the strength of ocean waves. Dams and other structures also influence the development of deltas. For example, construction of the Aswan High Dam in Egypt during the 1960's decreased the amount of sedi-



The delta of the Mississippi River, above, grows into the Gulf of Mexico at the rate of about 1 kilometre every 10 years. The Mississippi continuously deposits fertile soil in the delta.



The Nile Delta



The Mississippi Delta



ments that the Nile River carries to its delta. As a result, waves may wear away parts of the Nile Delta.

Deltas have fertile soil that makes them excellent agricultural areas. The rich land of the Mississippi Delta in Louisiana produces fruit, vegetables, and other crops. The Nile Delta has been farmed since ancient times. Some deltas, such as the Irrawaddy Delta in Burma and the Mekong Delta in Vietnam, support vast rice fields.

See also **Erosion** (How erosion occurs).

**Deluge**, according to the Bible, was a great flood that covered the earth thousands of years ago. It destroyed all living things except those God permitted to go into an ark built by Noah. The Deluge is described in two accounts combined in Genesis 6 to 8. In one version, God instructs Noah to save one male and one female of every animal. In the other, God tells Noah to take seven pairs of animals considered "clean" according to ancient dietary laws and one pair of "unclean" animals. Both accounts agree that God sent the flood to punish the wickedness of humanity.

Stories about great floods occur in the religious tradition of many peoples. An account is found in the Epic of Gilgamesh from Mesopotamia. Many scholars believe the Mesopotamian and Biblical accounts are related.

See also **Ararat**; **Ark**; **Deucalion**; **Noah**.

**Delusion** is a false belief. People with mental illness often have delusions. A common delusion is that of *grandeur*, in which people have an exaggerated idea of their importance. Other delusions include those of *persecution*, in which people believe they are being mistreated, and of *reference*, in which they falsely believe they are being talked about.

**Delyn** (pop. 66,200) is a local government district in Clwyd, Wales, administered from the town of Holywell. The district lies along the Dee estuary. Its other towns include Mold and Flint. Agricultural activities in the district include arable and dairy farming, and sheep rearing. Mold is a busy market town. Flint is the district's largest town. Industries in Delyn make paper, synthetic fibres, and woollens.

See also **Clwyd**.

**Demand**. See **Supply and demand**.

**Demarcation, Line of**. See **Line of Demarcation**.

**De Maupassant, Guy** (1850-1893), a French author, was one of the world's great short-story writers. He wrote clearly and simply. His tales are realistic, and reflect his often brutally sarcastic and pessimistic attitude toward people. But De Maupassant wrote with sympathy about the poor and outcasts of society.

De Maupassant's stories deal with many subjects, including the middle class, peasants, and government officials of France, the Franco-Prussian War, outdoor life, animals, and ghosts. He wrote about 250 stories, most of them between 1880 and 1890. He published them in several collections. The best known include *The Tellier House* (1881), *Yvette* (1885), *Toine* (1886), and *The Horla* (1887). His most famous stories include "Ball-of-Fat," "The Diamond Necklace," "The Umbrella," and "The Piece of String."

De Maupassant's novels have the same qualities his short stories have. *A Woman's Life* (1883) is a portrait of an unhappy country wife. *Bel-Ami* (1885) describes the rise of an unprincipled journalist. *Peter and John* (1888) is a psychological study of two brothers.

De Maupassant was born in Normandy, in northern France. He learned much of his literary technique and philosophy of life from his godfather, the famous French novelist Gustave Flaubert. De Maupassant died in an insane asylum.

**Demeter**, in Greek mythology, was the goddess of the earth, agriculture, fertility, and grain. The ancient Romans had a similar goddess and their name for her was Ceres.

The most famous myth about Demeter tells of her search for her daughter Persephone, whom the Romans called Proserpina. The girl had been kidnapped by Hades, the god of the dead, and taken to his kingdom in the underworld. For details of this myth, see **Persephone**.

The Greeks believed that people learned farming through Demeter. She gave Triptolemus, a Greek hero, a bag of seeds and sent him throughout the world in a magic chariot to teach people how to farm.

The most important centre of Demeter's worship was in Eleusis, near Athens. There, the Greeks held secret rituals called the Eleusinian Mysteries in her honour. The ceremonies were based on Demeter's search for her daughter. The Greeks also based these ceremonies on a belief in the immortality of the soul, and reward or punishment in a life after death.

See also **Ceres**; **Mysteries**.

**De Mille, Agnes** (1909-1993), became a leading American *choreographer* (dance composer), dancer, and author. She began her career as a dancer in 1929 and gave concerts in the United States and Europe until 1940. She then began creating ballets based on American themes. The first was *Rodeo* (1942). In 1943, she created and staged the dances for the musical play *Oklahoma!* This landmark musical was one of the first to successfully blend dancing, story, and music into a unified work. Many of her ballets are regularly performed by the American Ballet Theatre, including *Fall River Legend* (1948).

De Mille was born in New York City. She also became an author, writing the autobiographies *Dance to the Piper* (1952), *And Promenade Home* (1958), and *Where the Wings Grow* (1978).



Agnes De Mille danced in the 1942 première of her ballet *Rodeo* with Casimir Kokitch, left, and Frederic Franklin, right.



**De Mille, Cecil Blount** (1881-1959), an American film producer and director, became famous for his spectacular films based on the Bible. His first Biblical film was *The Ten Commandments* (1923). His final film as a director was a remake of this picture in 1956. A shrewd showman, De Mille balanced religion with romance in such films as *The Sign of the Cross* (1932) and *Samson and Delilah* (1949). His striking drama of Christ, *The King of Kings* (1927), was one of the few De Mille Biblical films to win praise from both critics and the clergy. He also made romantic adventures, including *The Plainsman* (1937), *Union Pacific* (1939), and *Unconquered* (1947). His circus spectacle, *The Greatest Show on Earth*, won the 1952 Academy Award for best picture.

De Mille was born in Ashfield, Massachusetts, and went to Hollywood in 1913. His early silent films, including *Male and Female* (1919) and *Forbidden Fruit* (1921), generally dealt with romance in high society.

**Democracy** is a form of government, a way of life, a goal or ideal, and a political philosophy. The term also refers to a country that has a democratic form of government. The word *democracy* means *rule by the people*. United States President Abraham Lincoln described such self-government as "government of the people, by the people, for the people."

The citizens of a democracy take part in government either directly or indirectly. In a *direct democracy*, also called a *pure democracy*, the people meet in one place to make the laws for their community. Such democracy was practised in the ancient Greek city-state of Athens.

Most modern democracy is *representative democracy*. In large communities—cities, states, provinces, or countries—it is impossible for all the people to take as a group. Instead, they elect a certain number of their fellow citizens to represent them in making decisions about laws and other matters. An assembly of representatives may be called a council, a legislature, a parliament, or a congress.

Most voting decisions in democracies are based on *majority rule*—that is, more than half the votes cast. A decision by *plurality* may be used when three or more candidates stand for election. A candidate with a plurality receives more votes than any other candidate, but does not necessarily have a majority of the votes. In some countries, elections to legislative bodies are conducted according to *proportional representation*. Such representation awards a political party a percentage of seats in the legislature in proportion to its share of the total vote cast.

Throughout history, the most important aspects of the democratic way of life have been the principles of individual equality and freedom. Accordingly, citizens in a democracy should be entitled to equal protection of their persons, possessions, and rights; have equal opportunity to pursue their lives and careers; and have equal rights of political participation. In addition, the people should enjoy freedom from undue interference and domination by government. They should be free, within the framework of the law, to believe, behave, and express themselves as they wish. Democratic societies seek to guarantee their citizens certain freedoms, including freedom of religion, freedom of the press, and freedom of speech. Ideally, citizens also should be guaranteed freedom of association and of assembly, free-

dom from arbitrary arrest and imprisonment, and the freedom to work and live where and how they choose.

Some people in democratic states have been eager to increase the role of government in society in order to make material conditions more equal for everyone. But other people have been concerned that the extension of government's role in such areas as welfare, education, employment, and housing may decrease the freedom of the people and subject them to too much government regulation. The supporters of more government involvement include *socialists* and *social democrats*. The critics of more government involvement are known as *conservatives*. The division between these groups has helped furnish one of the main themes of controversy and discussion in modern democratic societies.

Applying democratic principles in everyday life can be challenging. In countries with a written constitution, such as the United States, freedom of speech, press, religion, and assembly are protected by the constitution. In guarding these freedoms, a judiciary has to balance the interests of individuals against possible injury and damage to other people and the community. Thus, the right of free speech does not allow people falsely to damage the reputations of others. It also does not allow one to shout "Fire!" in a crowd when there is no fire.

This article presents a broad survey of democracy—what it is, how it works, and how it has developed. For more information on democracy and other forms of government, see the article on **Government**.

### Features of democracy

The characteristics of democracy vary from one country to another. But certain basic features are more or less the same in all democratic nations.

**Free elections** give the people a chance to choose their leaders and express their opinions on issues. Elections are held periodically to ensure that governments, both national and local, truly represent the people. The possibility of being voted out of office helps assure that those elected pay attention to public opinion.

In most democracies, the only legal requirements for voting or for holding elected office have to do with age, residence, and citizenship. The democratic process permits citizens to vote by secret ballot, free from force or bribes. It also requires that election results be protected against dishonesty. See **Election**.

**Majority rule and minority rights.** In a democracy, a decision must often be approved by a majority of voters before it may take effect. This principle, called majority rule, may be used to elect officials or decide a policy. Democracies sometimes decide votes by plurality. Most democracies require a vote higher than a simple majority to make fundamental or constitutional changes.

Majority rule is based on the idea that if all citizens are equal, the judgment of the many will be better than the judgment of the few. Democracy values freely given consent as the basis of legitimate and effective political power. But democracies are also concerned with protecting individual liberty and preventing government from infringing the freedoms of individuals. Democratic constitutions guarantee that certain rights can never be taken from the people, even by extremely large majorities. These rights include the basic freedoms of speech, press, assembly, and religious worship. The majori-



ty also must recognize the right of the minority to try to become the majority by legal means.

**Political parties** are a necessary part of democratic government. Rival parties make elections meaningful by giving voters a choice among candidates who represent different interests and points of view.

Some countries, such as the United States and Great Britain, have chiefly two-party systems.

Other democratic countries have two or three major parties and perhaps several smaller parties. In many countries, the single party gaining an overall majority at a general election forms the government. In democratic countries with multi-party systems an election may result in no single party having a majority. As a result, two or more parties must join to make up such a majority. These parties form a *coalition government*. In democratic countries, the party or parties that are out of power serve as the "loyal opposition." They are free to criticize the policies and actions of the party in power. In undemocratic countries, such as dictatorships, criticism of the party in power may be labelled as treason. Often, only the "government party" is allowed to exist. The people have no real choice among candidates, and no opportunity to express dissatisfaction with the government. See **Political party**.

**Controls on power.** Democracies have various arrangements to prevent any person or branch of government from becoming too powerful. In Australia, India, the United States, and many other countries there are both federal and state or provincial governments. Some powers belong only to the states, others only to the federal government, and still other powers are shared by both federal government and states.

Local government provides a further level of democratic government. In most democratic countries, elected councils have responsibility for certain local services.

In all democratic countries, government officials are subject to the law and are accountable to the people. Officials may be removed from office for lawless conduct or for other serious reasons. The communications media help keep elected officials sensitive to public opinion.

**Constitutional government.** Democratic government is based on law and, in most cases, a written constitution. Constitutions state the powers and duties of government and limit what the government may do. Constitutions also say how laws shall be made and enforced. Most constitutions have a detailed bill of rights that describes the basic liberties of the people and forbids the government to violate those rights. See **Bill of rights**.

Constitutions that have been in effect for a long time may include certain unwritten procedures that have become important parts of the operation of government. Such procedures are a matter of custom rather than written law.

Britain has no single written document called "the constitution." However, certain customs and convention, as well as certain major documents and many laws, are widely accepted as the "basic rules of the system." See **Constitution**.

An essential characteristic of democratic government is an independent judiciary. It is the duty of the justice

system to protect the integrity of the "rules" and the rights of individuals under these rules, especially against the government itself.

Occasionally, dictatorships establish very elaborate constitutions and extensive lists of basic rights of citizens. For example, the 1977 constitution of the Soviet Union contained more detailed rights supposedly guaranteed to citizens than does the U.S. Bill of Rights. In practice, however, Soviet courts were not known to defend individuals' rights against the government.

**Private organizations.** In a democracy, individuals and private organizations carry on many social and economic activities that are, for the most part, free of government control. For example, newspapers and magazines are privately owned and managed. Trade unions are run by and for the benefit of workers, not the state. Democratic governments generally do not interfere with religious worship. Private schools operate alongside state schools. The people may form groups to influence opinion on public issues and policies. Most businesses in democratic societies are privately owned and managed, although democratic governments may decide it is necessary to own and control certain basic industries and services.

### Why democracy?

The Declaration of Independence adopted by the American colonists in 1776 expressed the belief that "all men are created equal, that they are endowed by their Creator with certain unalienable rights, that among these are Life, Liberty, and the pursuit of Happiness." The Declaration said that the people may change or abolish the government if it interferes with those rights.

People once thought that the greatest obstacles to individual freedom and equality were political. They believed they could preserve freedom simply by changing the form of government from a monarchy to a republic. They claimed that the government that governs least governs best. But in time, many people became convinced that some government regulation of society and the economy was necessary to make personal freedom more meaningful and to promote equality, as well as to improve the welfare of the nation.

In today's democracies, there are extensive programmes to provide economic security, to ease suffering, and to develop human potential. Such programmes include unemployment insurance, minimum wage laws, old-age pensions, health service provision, civil rights laws, and finance for state education. Many democracies aim to provide a minimum standard of living and adequate medical care for all.

### Making democracy work

**Citizen participation.** Democracy calls for widespread participation in politics by the people. A few democracies have compulsory voting. But in most countries, it is believed to be the duty of all adult citizens to vote in local, state or provincial, and national elections. Qualified individuals should be willing to seek election for public office, to serve on juries, and to contribute to the welfare of their country. Citizens should help shape public opinion by speaking out on important issues and by supporting the political party of their choice. An active and informed citizenry is generally thought to be



one of the best guarantees against corrupt and inefficient government.

**Education and democracy.** Faith in the power of education is a characteristic of democracy. According to democratic ideals, widespread participation in politics does not necessarily ensure good government. The quality of government depends on the quality of participation. Well-informed and well-educated citizens are able to participate more intelligently.

A democracy needs educated citizens who can think for themselves. Citizens have a duty to take part in public affairs, to keep informed on public issues, and to vote intelligently. Democratic institutions must produce leaders worthy of public trust and responsibility. For this reason, democratic governments promote education for their citizens.

**Voluntary action.** An important quality of democratic government is its emphasis on trying to get people to act on the basis of understanding and agreement instead of force. Although all governments use force sometimes, democracies usually emphasize dialogue, negotiation, bargaining, and ultimately, voluntary citizen cooperation. This approach is closely linked to the widely held democratic belief that people are generally rational and well disposed toward the common welfare.

**Economic development and agreement on fundamentals.** Most successful democracies have existed in developed societies. In such societies, literacy rates are high, *per capita* (per person) incomes are moderate to high, and there are few extremes of wealth and poverty. Some scholars believe democracy works best in countries with a large middle class.

Many democratic governments have collapsed during economic crises. The basic problem involved in the failures of such democracies has been the inability to maintain sufficient agreement among either the people or their political leaders on the purposes of government. Crises have often aggravated and sharpened divisions and suspicions among various classes, groups, parties, and leaders. Excessive divisions have helped block action by freely elected governments, often resulting in widespread public frustration and disorder.

Democratic governments are likely to be unstable whenever people become deeply divided and suspicious of one another. Sometimes racial, ethnic, or religious differences make democracies difficult to operate. In such instances, the people may not see one another as legitimate and trustworthy partners in the enterprise of government.

### The development of democracy

**Origins of democracy.** Democracy began to develop in ancient Greece as early as the 500's B.C. The word *democracy* comes from the Greek words *demos*, meaning *people*, and *kratos*, which means *rule* or *authority*. Greek political thinkers stressed the idea of rule by law. They criticized dictatorship as the worst form of government. Athens and some other Greek city-states had democratic governments.

Democracy in ancient Athens differed in important ways from democracy today. Athenian democracy was a direct democracy rather than a representative one. Each male citizen had the duty to serve permanently in the assembly, which passed the laws and decided all important

government policies. There was no division between legislative and executive branches of the government. Slaves made up a large part of the Athenian population, and did most of the work. Neither the slaves nor women could vote.

The ancient Romans experimented with democracy, but they never practised it as fully as did the Athenians. Roman political thinkers taught that political power comes from the consent of the people. The Roman statesman Cicero contributed the idea of a universal law of reason that is binding on all people and governments everywhere. He suggested that people have natural rights which every state must respect.

**The Middle Ages.** Christianity taught that everyone is equal before God. This teaching promoted the democratic ideal of brotherhood among people. Christianity also introduced the idea that Christians are citizens of two kingdoms—the Kingdom of God and the kingdom of the world. It held that no state can demand absolute loyalty from its citizens because they must also obey God and His commandments. During the Middle Ages (A.D. 400's to the 1500's), the conflict between these two loyalties helped lay the foundation for constitutional government.

The Middle Ages produced a social system known as *feudalism*. Under feudalism, persons pledged their loyalty and services to one another. Individuals had certain rights which other persons were required to recognize. A feudal court system was established to protect these rights. Such courts later led to kings' councils, representative assemblies, and modern parliaments. See *Feudalism*.

**The Renaissance and the Reformation.** The great cultural reawakening called the Renaissance spread throughout Europe during the 1300's, 1400's, and 1500's. A new spirit of individual thought and independence developed. It influenced political thinking and hastened the growth of democracy. People began to demand greater freedom in all areas of life.

The new independence of the individual found religious expression in the Protestant Reformation. The Reformation emphasized the importance of individual conscience. During the early 1500's, Martin Luther, a leader of the Reformation, opposed the Roman Catholic Church as an intermediary between God and people. A number of Protestant churches were established during the period. Some of these churches practised the congregational form of government, which had a democratic structure. During the 1500's, both Catholics and Protestants defended the right to oppose absolute monarchy. They argued that the political power of earthly rulers comes from the consent of the people.

**Democracy in Britain.** In 1215, English nobles forced King John to approve the Magna Carta. This historic document became a symbol of human liberty. It was used to support later demands for trial by jury, protection against unlawful arrest, and no taxation without representation.

English democracy developed slowly during the next several hundred years. In 1628, Parliament passed the Petition of Right. The petition called on King Charles I to stop collecting taxes without the consent of Parliament. It also provided that Parliament should meet at regular intervals. Charles refused to agree to limits on the royal



power, and civil war broke out in 1642. Parliament, led by Oliver Cromwell, fought the followers of the king. Charles was beheaded in 1649, and the victors established a short-lived *commonwealth* (republic). See **Civil War, English**.

The English revolution of 1688 finally established the supremacy of Parliament. John Locke, the philosopher of the revolution, declared that final authority in political matters belonged to the people. The government's main purpose, he said, was to protect the lives, liberties, and property of the people. Parliament passed the Bill of Rights in 1689, assuring the people basic civil rights and liberties.

The Industrial Revolution brought new demands for democracy in Britain. The larger factory towns were not represented in Parliament until after the adoption of the Reform Bill of 1832. Property qualifications for voting disappeared only gradually. In 1918, for the first time, all men were permitted to vote. Not until 1928 could all women vote.

**French contributions to democracy** were made in the 1700's by such political thinkers as Montesquieu, Voltaire, and Jean Jacques Rousseau. Their writings helped bring about the French Revolution, which began in 1789. Montesquieu argued that political freedom requires the separation of the executive, legislative, and judicial powers of government. Voltaire spoke out against government invasion of individual rights and freedoms. Rousseau declared in his book *The Social Contract* (1762) that people "have a duty to obey only legitimate powers." The only rightful rulers, he added, were, ultimately, the people.

The French Revolution, an important event in the history of democracy, promoted the ideas of liberty and equality. The revolution did not make France a democracy, but it did limit the king's powers. See **French Revolution**.

**American democracy** took root in traditions brought to North America by the first English colonists. The Pilgrims, who settled in Massachusetts in 1620, joined in signing the Mayflower Compact to obey "just and equal laws." The American Revolution began more than 150 years later, in 1775. The colonists wanted self-government and no taxation without representation. The Declaration of Independence, adopted by the Continental Congress in 1776, is a classic document of democracy. It established human rights as an ideal by which government must be guided.

**The spread of democracy.** During the 1800's, democracy developed steadily. Many countries followed the American and British examples. Such democratic institutions as elections and legislatures became common. Where kings still ruled, they lost much of their power and performed mainly ceremonial duties.

The Industrial Revolution brought political changes of great importance. During the second half of the 1800's, the working classes demanded and received greater political rights. New laws gave more citizens the right to vote. The freedoms of speech, the press, assembly, and religion were extended and enlarged.

Democracy did not take root everywhere. Some countries that adopted democratic constitutions later became dictatorships. These nations found that a constitution alone did not guarantee democracy. In Russia, a

group of revolutionaries set up a Communist dictatorship in 1917 and halted Russia's progress toward democracy. Germany adopted a democratic government in 1919, but Adolf Hitler's rise to power brought a fascist dictatorship in 1933.

**Commonwealth democracies.** Many of Britain's former colonial territories initially adopted a "Westminster-style" democracy on gaining independence. In Australia the emergent states resisted the idea of a single federal government until 1901, and today power is shared between the federal and state governments. India is now the world's largest democratic state, with a constitution that took effect in 1950. It combines elements of British and United States constitutionalism and guarantees the basic equal rights of every citizen. In some Commonwealth countries, such as Zimbabwe, the government moved from a British-style multiparty system to a one-party system. Some retain the Queen as their head of state, but most are republics.

**Democracy today.** Most governments today claim to be democratic, but many lack some essential freedoms which are usually associated with democracy. For example, they lack freedom of speech and of the press, of assembly and meeting in public places, or competitive elections.

Many modern nations have a long history of democratic government. These countries include Australia, Belgium, Canada, Denmark, the Netherlands, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States. Other nations—including India, Israel, Italy, and Japan—have been democracies since the mid-1900's. The structure of French government has changed many times since the French Revolution. The present government is a democracy. The European parliament is a step towards democratic control of the affairs of the European Community.

Several newly independent nations in Africa and Asia are trying to develop democratic institutions. But inexperience with self-rule, and other problems, have made democratic government difficult to achieve. In the late 1980's and early 1990's, democracy increased in the Soviet Union and Eastern Europe as Communists lost control of the governments of the Soviet Union and many Eastern European countries.

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**Democratic Party** is the older of the two major political parties of the United States. The Republican Party is the other.

The Democratic Party has played a vital role in the history and politics of the United States. From 1828 to 1888, Democrats won 18 of the 41 presidential elections. They dominated U.S. politics from 1828 until 1856, winning 6 of the 8 presidential elections. From 1860 until 1928, they won only 4 of the 18 presidential elections. But the Democratic candidate won 8 of the 15 presidential elections held from 1932 to 1988. Traditionally, the Democratic Party has drawn support from several groups, including many immigrants, Southerners, wage earners, and—since the 1930s—blacks.

The policies of the Democratic Party, like those of other parties, have changed with the flow of history. Until Woodrow Wilson became President in 1913, the Democrats generally approved a strict interpretation of the U.S. Constitution and favoured a limitation on government powers. As President, Wilson expanded the role of government and mobilized the country to help defeat Germany in World War I (1914-1918). Franklin D. Roosevelt boldly took government action to pull the United States through the Great Depression of the 1930s. During World War II (1939-1945), Roosevelt again expanded government powers to fight Germany and Japan.

Some Democrats thought Roosevelt extended the government's powers too far. Others believed these powers had not been extended far enough. Ever since Roosevelt's presidency, Democrats have disagreed on how extensive the role of government should be.

**Origin** of the Democratic Party is uncertain. Some historians trace its beginnings to the Democratic-Republican Party that Thomas Jefferson created during the 1790s. Most historians, however, regard Andrew Jackson's presidential campaign organization, formed in 1828, as the beginning of the Democratic Party as it is known today. By the late 1830s, Jackson's supporters called themselves Democrats and had become an organized political party.

In the period leading up to the American Civil War (1861-1865), Democrats were divided into northern and southern factions over the slavery issue. During the war, those Democrats who supported Republican President Abraham Lincoln were known as "War Democrats"; those who opposed Lincoln and the war were "Peace Democrats". In 1884, Grover Cleveland became the first Democrat since the civil war to win election as President.

**The modern party.** The Democratic Party enjoyed dominance under presidents Woodrow Wilson and Franklin D. Roosevelt, when the government assumed growing involvement in the life of Americans. The Great Depression brought a revolution in the party's fortunes. Democrats won every presidential election of the 1930s and 1940s, because of the overwhelming popularity of Roosevelt's New Deal policies for economic relief, recovery and reform.

Similar enthusiasm greeted John F. Kennedy's New Frontier programme in 1960, but Lyndon Johnson's

Great Society policies were overshadowed by the Vietnam War. Since 1969, except for the one-term presidency of Democrat Jimmy Carter (1976-1980), Republicans have held the presidency. However, the Democrats have usually controlled Congress. In 1984, Democrat Geraldine Ferraro became the first woman presidential candidate of a major U.S. political party. Jesse Jackson campaigned to be the party's first black nominee for president in 1988. The 1988 election was won by the Republican candidate, George Bush. In 1992, the Democratic Party elected Bill Clinton, the governor of Arkansas, as its nominee for the presidency.

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**Democrats, The.** See **Democratic Party.**

**Democritus** (460?-370? B.C.) was a Greek philosopher. He argued that the world consisted of an infinite number of atoms moving in an infinite void. These atoms are invisible and indivisible particles of matter that were ungenerated and indestructible. They differ from one another in size, shape, and position. Each thing in the world is a different combination of these atoms. Our world came about as the chance combination of atoms, and since there are an infinite number of atoms, innumerable other worlds also have come to be.

Democritus believed all sensation is a form of touch resulting from atoms colliding with the sense organs. But the senses do not provide true knowledge of reality. He reasoned that the senses reveal a world of colours, smells, and tastes while, in reality, only atoms and the void exist. According to Democritus, true knowledge—that of the atoms and the void—comes from the intellect, not the senses.

Democritus was born in Abdera in northern Greece. He wrote on ethics, physics, mathematics, literature, and language, but only fragments of his works survive. We know of his theory of atomism through the testimony of other ancient authors.

See also **Atomism; Pre-Socratic philosophy.**

**Demography** is the study of human populations. *Demographers* (population experts) study such characteristics as age, number, distribution, and sex of people in an area. This information comes from a population census or national sample survey. Most nations conduct censuses, usually once every 10 years. Demographers also study population change, which is the result of births, deaths, movement of people, and changes in population characteristics.

People in government, business, and other occupations use demographic methods to study aspects of a society or economy. Business people want to know such *demographics* (demographic data) as the age, sex, income level, life style, location, and consumer habits of people that are likely to be in the market for their products.

See also **Census; Population; Sociology** (Population studies); **Vital statistics.**

**Demon.** See **Devil; Devil worship.**

**Demosthenes** (384?-322 B.C.) was an Athenian statesman who is usually considered to have been the greatest Greek orator. He is best known for his *Philippics*, a series of speeches that attacked King Philip II of Mace-



donia as a threat to Greek independence. Today, the term *philippic* means a *bitter attack in words*.

Demosthenes was the son of a wealthy Athenian. His father died when he was a boy, and Demosthenes was raised by three guardians. The guardians stole most of his inheritance. But Demosthenes studied law and oratory, and this training helped him when he brought his guardians to court after he reached adulthood. His lawsuit against them went so well that he entered politics.

Demosthenes overcame great difficulties to become an orator. He had a harsh voice, an awkward manner, and suffered from shortness of breath. According to legend, he learned to speak properly by shouting above the roar of ocean waves with his mouth full of pebbles.

Demosthenes was one of the first people to recognize the ambition of Philip II to take over Greece. He urged the Athenians to pay the taxes needed to strengthen their army and navy, and to serve in the armed forces themselves instead of relying on hired soldiers. He was only partially successful in rousing the Athenians to resist Philip's growing power in Greece.

Philip gained control of Delphi, in central Greece, by 346 B.C. At that time, Greece was divided into independent *city-states*, each of which consisted of a city and its surrounding territory. Demosthenes urged the city-states to join forces to oppose Philip. He eventually persuaded the powerful city-states of Athens and Thebes to form an alliance.

Philip defeated the armies of Athens and Thebes at the Battle of Chaeronea, near present-day Levadhia, in 338 B.C. Athens made peace, but Demosthenes continued to oppose Macedonian rule. He defended his policy with his oration "On the Crown," which many experts consider the most nearly perfect speech in history.

In 323 B.C., Demosthenes rallied the Greeks for another attack on Macedonia. But the attack failed, and he poisoned himself to avoid capture.

See also **Philip II**.

**Demotic.** See Hieroglyphics; Greek language (Modern Greek).

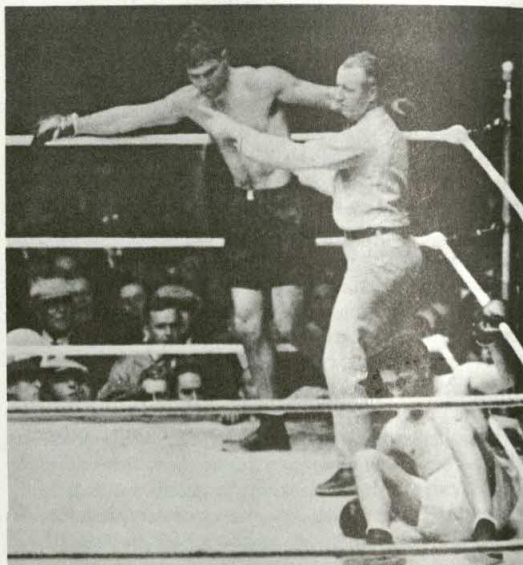
**Dempsey, Jack** (1895-1983), became one of the most popular heavyweight boxing champions of all time. He was also one of the most fearsome with over 25 first-round knockouts, more than any fighter in history. He knocked out Jess Willard in 1919 to win the title. Dempsey lost the title in 1926 to Gene Tunney. Their second fight, in Chicago in 1927, featured the famous "long count." Dempsey knocked Tunney down in the seventh round. But he did not go to a neutral corner immediately, so referee Dave Barry delayed starting the count over Tunney. Tunney rose at the count of 9, but observers estimated this was equal to a count of 14. Tunney went on to win the fight on points.

William Harrison Dempsey was born in Manassa, Colorado, U.S.A. He started fighting professionally in 1914. Dempsey was nicknamed the *Manassa Mauler* by sports journalist Damon Runyon. He discussed his boxing career in his autobiography, *Dempsey* (1977).

See also **Boxing**; Tunney, Gene.

**Dempster, Arthur Jeffrey** (1886-1950), was an American physicist. In 1935, he discovered uranium 235 (U-235), the rare isotope of the element uranium. The U-235 isotope is a key substance in the atomic bomb.

Dempster's highly accurate determinations of the



**Jack Dempsey** knocked down defending heavyweight champion **Gene Tunney** in the famous "long count" fight in 1927.

masses of many elements and isotopes are of fundamental importance in nuclear physics. They provide the means for measuring mass and energy transformations. He developed a *mass spectrograph*, an instrument for weighing and sorting out atoms by their mass. He made important contributions to the work of the Manhattan Project, a United States government agency that directed the development and production of the atomic bomb during World War II.

Dempster was born in Toronto, Ontario, Canada, and graduated from the University of Toronto. He moved to the United States in 1914, and he became a United States citizen in 1918. In 1916, Dempster took his doctor of philosophy degree at the University of Chicago. He became professor of physics there in 1927.

See also **Isotope**; U-235.

**Den.** See **Bear** (Cubs); **Fox** (picture: Dens); **Lion** (Cubs); **Wolf** (Young).

**Denarius** was a silver coin used by the Romans during the periods of the Republic and the Empire. The Romans first issued the coins about 211 B.C. The denarius disappeared from circulation in the A.D. 200's. The silver denarius by that time had been replaced by one struck from *billon*, an alloy made with copper and a small



This **denarius**, which was issued from A.D. 14 to 37, carries the portrait of the Roman emperor **Tiberius** on its front side.



amount of silver. The value of the denarius first equalled 10, and later 16, of the copper coins called *asses*. The standard gold coin of the Roman Empire was the *aureus*. It was about the same size as the denarius and was worth 25 denarii. The denarius was the penny referred to in the New Testament.

**Denbighshire.** See Clwyd.

**Dendrochronology.** See Archaeology (Dating).

**Deneb** is the brightest star in the constellation Cygnus, or the Swan. Deneb is also called *Alpha Cygni*. It is one of the most brilliant stars visible to the unaided eye, having a magnitude of 1.26 (see **Magnitude**). Deneb is 60,000 times as bright as the sun, but it appears faint because it is about 1,600 light-years away (see **Light-year**). Deneb appears bluish-white due to its extremely high surface temperature of at least 10,000° C. Astronomers classify the star as a *blue supergiant*. Deneb's diameter is about 70 times that of the sun.

See also **Astronomy** (map: The stars and constellations of the Northern Hemisphere).

**Deng Xiaoping** (1904- ), also spelled *Teng Hsiao-p'ing*, is the most influential leader in China. In theory, the Communist Party's general secretary is China's most powerful official. But China's official leaders consult Deng on all major issues and decisions, and he continues to be a leader of great importance. His influence has enabled him to bring about major changes in China. Deng no longer holds a post in the Chinese government, but he remains influential.

**His leadership.** Mao Zedong, who had been China's top leader, died in 1976. Deng then emerged as the moving force behind cultural, economic, and political changes that began to occur in the country. These changes were a response to the radical Communist policies of Mao. Under Deng's leadership, cultural contacts and trade between China and other countries increased. Deng also decreased the Communist Party's regulation of business activity.

As a result of Deng's economic changes, China's economy grew and living conditions improved. However, the changes led to inflation and created more social inequality. Also, some of China's Communist Party leaders opposed Deng's policies.

Deng's policies also brought some political openness to Chinese society. But many citizens called for a greater degree of democracy. In 1989, large numbers of people, especially students, demonstrated for more democracy. Large numbers of them were killed by the military. Deng had backed a strong response against the demonstrators. This position weakened the respect that he had commanded.

Deng has used ideas from both Communism and other systems of government to modernize China's economy. In 1962, Deng demonstrated his political flexibility by his statement: "It does not matter whether a cat is black or white so long as it catches mice."

**His life.** Deng was born Deng Xixian in the province of Sichuan, also called Szechwan, into a family of landowners. He became engaged in revolutionary activities while working and studying in France during the early 1920's. Deng joined the Communist Party in 1924.

In 1927, fighting began between the Chinese Communists and the ruling Nationalists. Deng commanded Communist soldiers against Nationalists. The Commu-

nists won control of China in 1949. Deng had been elected to the Central Committee of the Communist Party in 1945. In 1955, he became a member of the party's Politburo—China's chief policymaking body. In 1956, he was appointed general secretary of the Communist Party—then one of the highest posts.

In the early 1960's, Deng came into conflict with party leader Mao Zedong over the amount of control the Communist Party should have in China. Deng believed that Mao's strict allegiance to Communist principles had damaged the economy. Deng and many others who opposed Mao were removed from office during China's Cultural Revolution (see **China** [The Cultural Revolution]). Deng returned to politics in 1973, only to be deposed again in early 1976. After Mao's death in September 1976, Deng emerged as the top leader in China.

**Dengue**, also called *breakbone fever*, is a disease that causes fever, head and eye aches, and pain in the muscles and joints. It may also cause a runny nose, sore throat, and skin rash. Dengue is caused by a virus that is carried by mosquitoes. Symptoms of the disease appear three to six days after a disease-bearing mosquito bites the victim. The rash breaks out on the fifth day of the illness. The fever subsides and then usually rises again. The disease is seldom fatal, but it can trigger a fatal reaction—called *dengue haemorrhagic shock syndrome*—chiefly in young children and elderly people.

See also **Virus**.

**Denim** is a sturdy fabric commonly used for jeans and other durable clothes. It is made from cotton, synthetic fibres, or a blend of both. The cloth is woven in the *twill weave* pattern (see **Weaving** [The twill weave]). Denim was first woven in Nîmes, France, about A.D. 300 and was called *serge de Nîmes*. In the late 1800's, the American clothing manufacturer Levi Strauss produced the first blue denim jeans. See also **Strauss, Levi**.

**De Niro, Robert** (1943- ), is an American film actor. He is best known for his portrayals of intense, psychologically troubled characters. De Niro received the 1980 Academy Award as best actor for his portrayal of boxer Jake LaMotta in *Raging Bull*. He also won the 1974 Academy Award as best supporting actor for his performance as gangster boss Vito Corleone in *The Godfather, Part II*. De Niro received Academy Award nominations as best actor for his roles as a mentally disturbed killer in *Taxi Driver* (1976) and as a Vietnam War veteran in *The Deer Hunter* (1979).

De Niro was born in New York City. He studied under the famous acting teachers Lee Strasberg and Stella Adler. De Niro appeared in a number of plays in New York City before making his film debut in 1968 in *Greetings*. De Niro's other films include *Mean Streets* (1973), *Bang the Drum Slowly* (1973), *The King of Comedy* (1983), *Once Upon a Time in America* (1984), *Falling in Love* (1984), *Midnight Run* (1988), *Jackknife* (1989), and *We're No Angels* (1989).

**Denis, Saint** (A.D. 200's), is the patron saint of France. He is sometimes called Saint Dionysius. Saint Gregory of Tours reported that Denis was sent to preach the gospel in Gaul during the reign of Emperor Decius (249-251). Denis became bishop of Paris and died a martyr. His feast day is October 9. Denis was often confused with Dionysius the Areopagite, a legendary figure portrayed as a convert of Saint Paul.





Denmark's charm and prosperity are evident in the well-maintained old buildings and fashionable cafés of Copenhagen's Nyhavn Canal. Copenhagen is the capital and largest city of Denmark, as well as the country's cultural, economic, and political centre.

## Denmark

**Denmark** is a small kingdom in northern Europe that is almost surrounded by water. It consists of a peninsula and 482 nearby islands. The peninsula, called Jutland, shares a 68-kilometre border with Germany. Greenland, off the northeastern coast of Canada, is a province of Denmark even though it lies 2,090 kilometres away. The Faeroe Islands, north of Scotland, are a self-governing part of the Danish kingdom. Denmark, along with Norway and Sweden, is one of the Scandinavian countries.

More than half of the Danes (people of Denmark) live on the islands near the peninsula. Copenhagen, the capital and largest city of Denmark, is on the largest island. About a quarter of all Danes live in the Copenhagen area, and almost half of the country's manufacturing industries are located there.

Denmark has one of the world's highest standards of living. The Danes have achieved prosperity even though their land is poor in natural resources. They sell their products to other countries to pay for the fuels and metals they must import for their industries.

Denmark is famous for its farm products, particularly butter, cheese, bacon, ham, and other processed foods. It is also known for its beautifully designed manufactured goods, including furniture, porcelain, and silverware. Since the Viking era, the Danes have been a seafaring people, and Denmark is still one of the world's great shipping nations. Fishing has always played an important part in Denmark's economic life. The rich fishing grounds in the country's coastal waters and in the North Sea continue to ensure that fishing remains a major industry.

Denmark is a land of small green farms, blue lakes, and white coastal beaches. The carefully tended farmlands make up about three-quarters of the country. In

the farm areas, the roofs of most houses are made of red or blue tiles, or are thatched. Storks, which the Danes believe bring good luck, build nests on some rooftops. Castles and windmills rise above the rolling landscape. Visitors can enjoy Denmark's charm even in the busy, modern cities, with their well-preserved sections of colourful old buildings and cobblestone streets.

### Government

**National government.** Denmark is a constitutional monarchy with a king or queen, a prime minister and

### Facts in brief about Denmark

**Capital:** Copenhagen.

**Official language:** Danish.

**Official name:** *Kongeriget Danmark* (Kingdom of Denmark).

**Area:** 43,077 km<sup>2</sup>. *Greatest distances*—east-west, 402 km; north-south, 362 km. *Coastline*—1,701 km.

**Elevation:** *Highest*—Yding Skovhøj, 173 m above sea level. *Lowest*—sea level along the coasts.

**Population:** *Estimated 1996 population*—5,203,000; density, 121 people per km<sup>2</sup>; distribution, 86 per cent urban, 14 per cent rural. *1981 census*—5,123,989. *Estimated 2001 population*—5,251,000.

**Chief products:** *Agriculture*—barley, beef and dairy cattle, eggs, pigs, milk, potatoes, poultry, sugar beet, wheat.

*Fishing*—cod, sand lances, trout. *Manufacturing*—bacon, butter, cheese, diesel engines, electrical and electronic equipment, furniture, ham, machinery, porcelain, ships, silverware.

**National holiday:** Constitution Day, June 5.

**National anthems:** "Kong Christian stod ved højen mast" ("King Christian Stood by Lofty Mast") and "Der er et yndigt land" ("There Is a Lovely Land").

**Money:** *Currency unit*—Danish krone. One krone = 100 øre.





**Christiansborg Palace** is the home of Denmark's parliament, the *Folketing*. It also houses the Supreme Court and the Queen's Audience Chambers, where formal functions are held.

cabinet, and a parliament. The government is based on the Danish constitution of 1953, which divides the government into three branches—executive, legislative, and judicial. The monarch serves as head of state but has little real power.

The monarch appoints the prime minister of Denmark. The prime minister must have the support of a majority of the members of the Danish parliament. If one political party controls a clear parliamentary majority, the leader of that party normally becomes the prime minister. However, the large number of parties in Denmark makes it almost impossible for any single party to win a majority. If no party has a majority, the person who can gain the support of the strongest *coalition* (combination of parties) becomes the prime minister. A prime minister who receives a vote of no confidence from the parliament must either (1) resign, along with the rest of the cabinet; or (2) ask the monarch to dissolve the parliament and call a national election.

The prime minister heads the cabinet. The cabinet consists of a variable number of ministers, each of whom normally heads a government department. The monarch selects the members of the cabinet based on the prime minister's recommendations. The main executive powers are exercised by the cabinet in the monarch's name. However, the cabinet remains in power only as long as it has the support of a majority of the members of parliament.

Other high officials in Denmark, including judges, are named by the monarch on the advice of the cabinet. The parliament appoints an official called an *ombudsman*, who investigates citizens' complaints against actions or decisions by the government (see **Ombudsman**).

The Danish parliament, called the *Folketing*, consists of one house. It has 179 members, who are elected to four-year terms. One hundred and seventy-five are elected from Denmark, 2 from Greenland, and 2 from the Faeroe Islands. Of the seats from Denmark, 135 are filled by elections in voting districts and 40 are divided among the various political parties according to their

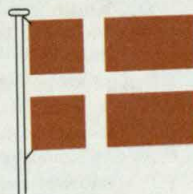
share of the total votes in the election. All Danish citizens at least 18 years old may vote.

Members of the Folketing discuss and vote on proposed legislation. Certain kinds of bills passed by the Folketing are subject to approval by the Danish voters. The people of Denmark also must be given the opportunity to vote on a bill if one-third of the Folketing's members call for such action.

**Courts.** Denmark's highest court is the Supreme Court. It consists of 15 judges, at least 5 of whom must hear each case. There are also two High Courts, with a total of about 50 judges. At least 3 High Court judges and a jury of 12 persons hear serious criminal cases. A jury verdict of innocent is final, but the judges may reverse a verdict of guilty. The judges and jurors act together to set the length of prison sentences. There are more than 100 lower courts.

**Local government.** Denmark is divided into 14 counties and 2 large municipalities—Copenhagen and Frederiksberg. The 14 counties are subdivided into almost 300 smaller municipalities. In most cases, a municipality consists of an urban centre and a rural area. Each county and municipality in Denmark has a council elected by the people. Each council selects a mayor to head the local government.

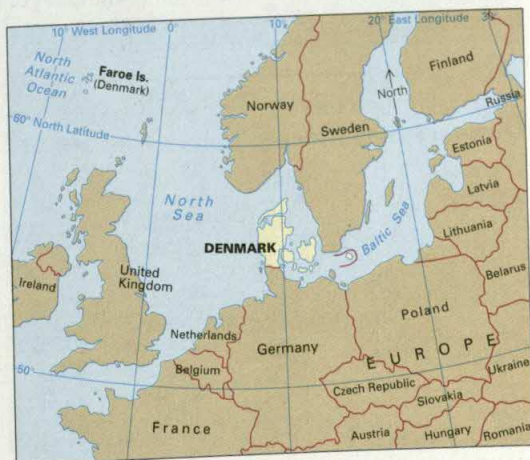
**Politics.** Denmark has many political parties. The two largest parties are the Social Democratic Party and the Conservative People's Party. The Social Democrats sup-



The Danish flag was probably first used in the 1200s, after King Valdemar II led a military crusade to Estonia.

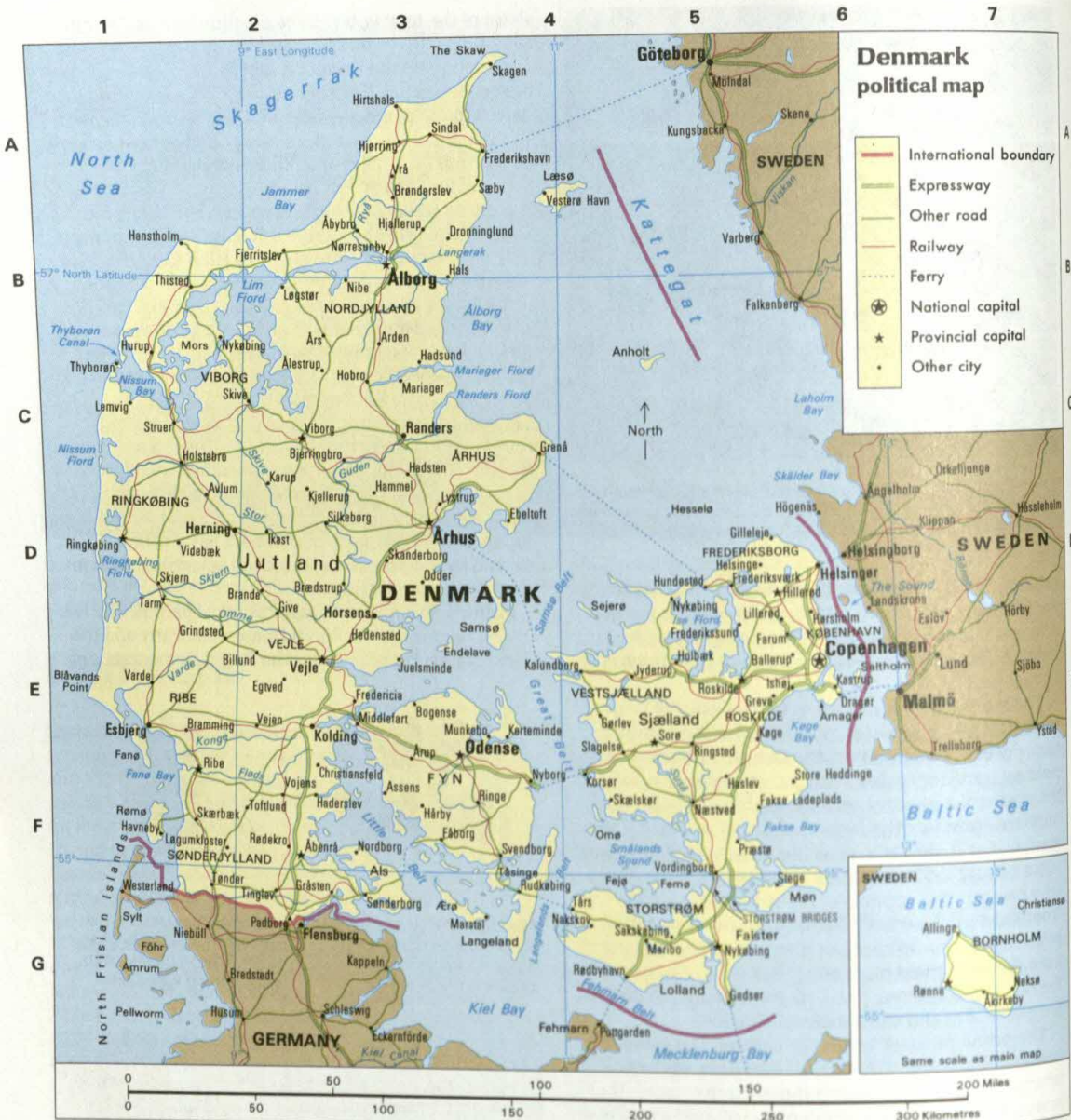


Denmark's coat of arms dates from the 1100s. The lions of the Valdemar arms stand among water lilies.



**Denmark** is a small country in northern Europe. It consists of the peninsula of Jutland and hundreds of nearby islands.





## Denmark map index

### Counties

Århus	582,229	C	3
Bornholm	47,164	G	7
Frederiks- borg	334,952	D	5
Fyn	454,278	F	3
Køben- havn	612,219	E	6
Nordjyl- land	481,963	B	3
Ribe	215,405	E	1
Ring- kebing	264,531	D	1
Roskilde	208,986	E	5
Sønderjyl- land	249,665	F	2
Storstrøm	257,060	G	5
Vejle	326,853	E	2
Vestsjæl- land	278,782	E	4
Viborg	230,376	C	2

### Cities\*

Åbenrå	21,299	F	2
Ålborg	154,878	B	3
Århus	253,761	D	3
Ballerup	46,349	E	6
Brønderslev	20,202	A	3
Copenhagen (Køben- havn)	472,729	E	6
Dragør	11,358,540	E	6
Dronning- lund	12,616	E	6
Egtved	15,209	B	3
Esbjerg	80,698	E	1
Fåborg	17,375	F	3
Farum	16,991	E	3
Fredericia	45,816	E	3
Frederiks- berg†	87,303	E	6

Frederiks- havn	35,577	A	4
Frederiks- værk	17,586	D	5
Gentofte	66,108	E	6
Gladsaxe	61,829	E	6
Grenå	18,541	C	4
Grinsted	44,254	E	2
Greve	30,213	F	3
Haderslev	17,056	E	3
Haslev	13,611	F	3
Hedensted	13,922	F	3
Helsingør	17,183	D	3
Helsingør	56,637	D	6
Hillerød	56,040	D	2
Hirtshals	33,578	F	3
Hjørring	34,483	A	3
Hobro	13,904	C	3
Heje Tås- trup†	43,568	E	6
Holbæk	30,673	E	3
Holstebro	37,823	C	1

Horsens	54,646	D	3
Hørsholm	23,090	D	6
Hvidovre	50,041	E	6
Ikast	21,121	D	2
Isbøl	20,728	E	6
Juelsminde	14,583	E	4
Kalundborg	19,443	E	3
Kjellerup	13,486	D	2
Køge	35,931	E	2
Kolding	56,988	E	2
Lemvig	20,277	F	4
Lymby	19,418	E	1
Tarboek	49,972	E	6
Middelfart	18,131	E	2
Næstved	44,849	F	3
Nakskov	16,595	G	4
Nordborg	14,818	F	3
Nyborg	18,281	F	4
Nykøbing	25,094	G	3
Odder	17,998	D	3
Odense	172,851	E	3
Randers	61,044	C	3

Ribe	17,876	F	2
Ringkebing	16,859	D	1
Ringsted	28,471	E	5
Roskilde	15,437	G	5
Roskilde	48,981	E	3
Sæby	17,856	A	2
Silkeborg	47,953	A	4
Skagen	13,953	A	4
Skanderborg	19,407	D	3
Skive	33,764	E	2
Slagelse	27,651	F	3
Sønderborg	27,651	F	3
Sorø	14,041	E	1
Struer	19,986	F	4
Svendborg	29,859	B	1
Thisted	18,669	E	1
Varde	15,812	E	2
Vejle	50,262	E	2
Vejle	30,504	E	2
Viborg	17,072	F	2
Vojsen	20,064	F	5

\*Population of municipalities, which may include rural as well as the urban centre.

†Population of metropolitan area, including suburbs.

Does not appear on map; key shows general location.

Source: 1986 official estimates for municipalities; 1985 official estimates for counties and Copenhagen metropolitan area.



port strong social welfare programmes, full employment, and public ownership of the means of production. They formed alliances with various smaller parties and dominated Danish politics from the 1930's to the 1970's. The Conservatives favour limited government involvement in the economy. A radical party called the Progress Party opposes immigration into Denmark and favours eliminating income taxes and most of the civil service. Other Danish political parties include the Centre Democratic, Christian People's, and Liberal parties.

**Armed forces.** A total of more than 30,000 people serve in Denmark's army, navy, and air force. Men from 20 to 25 years of age may be conscripted for nine months' service in the armed forces.

## People

**Population and ancestry.** Denmark has about 5 million people. Copenhagen, the largest city, has about 470,000 people. About a fourth of all Danes live in Copenhagen or its suburbs. Three other Danish cities have populations of more than 100,000. They are, in order of size, Århus, Odense, and Ålborg. See the articles on the Danish cities listed in the *Related articles* at the end of this article.

The Danes are closely related to the Norwegians and the Swedes. Denmark's only ethnic minority group consists of about 40,000 people of German ancestry. They live in southern Jutland, along Denmark's border with Germany.

**Language.** Danish, the official language of Denmark, is closely related to the Norwegian and Swedish languages. Regional dialects abound and are especially noticeable in northern Jutland and on the island of Bornholm. German is spoken by the ethnic German minority. Virtually all adult Danes also speak English.

## Way of life

**City life.** More than four-fifths of all Danes live in urban areas. The principal cities of Copenhagen, Århus, Odense, and Ålborg feature a striking combination of medieval structures, such as castles and cathedrals, and modern office buildings and homes. Denmark's high standard of living and extensive social welfare services ensure that the cities have virtually no slums or sub-standard housing. Most city dwellers live in flats. Many suburban residents live in single-family houses. Service industries employ most people in urban areas.

Danish cities are served by an extensive network of public transportation. Modern trains whisk people from the suburbs to the city centres. Trains also link cities to one another. Bicycles, buses, and cars provide the chief means of transportation within the cities. The growth of the urban population and the resulting increase in the number of cars and trucks have led to problems of traffic congestion and pollution, especially in Copenhagen. Industrial pollution, however, has decreased, as many urban factories that once burned coal for power now rely on natural gas.

**Rural life.** Less than a fifth of the Danish people live in rural areas. But although cities dominate Denmark's economic and social life, the nation's many farms and rural villages show the continuing importance of agriculture. Danish farms are not large, and most are owned and operated by the people who live on them. Most res-



**Colourful shops and restaurants** cluster in an area of Copenhagen called Strøget, which is closed to motor traffic.

idents in rural regions live in modernized single-family homes.

**Food and drink.** Most Danes eat four meals a day—breakfast, lunch, dinner, and a late-evening supper. Breakfast generally consists of cereal, cheese, or eggs. Dinner, which includes fish or meat, is usually the only hot meal. A favourite traditional Danish dinner consists of roast duckling stuffed with apples and prunes, served with red cabbage and boiled potatoes.

The chief part of the other Danish meals consists of open-faced sandwiches called *smørrebrød*. One sandwich may be a pyramid-shaped pile of about 20 small shrimps on thin bread. The Danes often prepare a plate of *smørrebrød* almost as a work of art, with many attractive sandwiches.

Denmark is famous for rich, flaky raised sweet rolls that are often called *Danish pastries*. Danes especially enjoy a nut-filled coffee cake called *kringle*. Typical des-



**Danish farmers** use modern equipment, such as this combine harvester. Most Danish farms are family-owned and operated.



serts eaten by Danes include berry puddings and rice pudding.

The Danish people typically drink coffee with breakfast and during morning and afternoon breaks from work. Many Danes drink beer with meals. On special occasions, they also may drink *aquavit*, a strong drink slightly flavoured with caraway.

**Religion.** About 97 per cent of the Danish people belong to the Evangelical Lutheran Church, the official church of Denmark. The monarch is required by law to belong to the church, but the people have complete freedom to worship as they please. The church is supported largely by a national tax paid only by members. The Evangelical Lutheran Church has no supreme spiritual leader. Ten bishops manage church affairs. The Danish parliament has control of the church but does not interfere in its religious practices. Roman Catholics make up Denmark's second largest religious group.

**Education.** Almost all adult Danes can read and write. Danish law requires children to attend nine years of school. Primary school consists of the first seven grades, and secondary school lasts from three to five years. A five-year secondary education makes a student eligible to enter a university. Denmark has three universities. The University of Copenhagen is the oldest and largest. It was founded in 1479 and has about 24,000 students. The others are those of Århus and Odense.

The famous Danish folk high schools operate separately from the state educational system. They are private schools, but are supported largely by government funds. These schools provide young adults with a general education in Danish government, history, and literature. Courses last up to six months, and the students live at the schools. Denmark has about 20 folk secondary schools. The first ones were founded in the mid-1800's to help young farmers take a more active part in Denmark's political and social life. Today, the schools also attract many young adults of the cities and towns.

**Libraries and museums.** The chief libraries include the Royal Library in Copenhagen, founded in the mid-1600's. It is Denmark's national library, and has about 2½ million books. Other leading libraries in Denmark include the University Library in Copenhagen, and the State and University Library in Århus. The Danish government supports a nationwide system of about 250 public libraries.

Denmark also has about 280 museums. Many important museums are located in Copenhagen. The National Museum houses exhibits that document Danish history from prehistoric to modern times. Fine paintings and sculptures by Danish and other European artists are on display in the State Museum of Art. The New Carlsberg Glyptotek features ancient Egyptian, Etruscan, Greek, and Roman art. The Louisiana Museum, south of Helsingør, is noted for its collection of modern art. The Viking Ship Museum in Roskilde houses five Viking ships dating from the A.D. 1000's.

**Arts.** Many Danes have won fame in the arts, especially in literature. Ludvig Holberg is known as the father of modern Danish literature. During the early 1700's, he wrote poems and plays that poked fun at Danish society (see *Holberg, Ludvig*). Johannes Ewald, who did much of his writing during the 1770's, became one of Denmark's greatest lyric poets.

Important literary works of the 1800's include the romantic poems of Adam Oehlenschläger and the hymns of N. F. S. Grundtvig. Hans Christian Andersen won world fame for his fairy tales and is probably Denmark's best-known writer (see *Andersen, Hans Christian*). The books of Søren Kierkegaard strongly influenced the development of the modern philosophy called *existentialism* (see *Kierkegaard, Søren*).

Henrik Pontoppidan and Johannes V. Jensen rank among the most important Danish novelists of the early 1900's. Each won the Nobel Prize for literature, as did Karl Gjellerup. Other noted Danish writers include Thorild Bjørnvig, Isak Dinesen, Martin A. Hansen, and Martin Andersen Nexø. See *Dinesen, Isak*.

Carl A. Nielsen is considered Denmark's greatest musical composer. He wrote six symphonies and many other works, including the comic opera *Maskarade* (see *Nielsen, Carl A.*). In the field of dance, the ballet master August Bournonville made the most significant Danish contribution. The Royal Danish Ballet flowered under his direction during the mid-1800's, and today it enjoys a worldwide reputation.

Noted Danish painters include Michael Ancher, C. W. Eckersberg, Oluf Høst, Christen Købke, P. S. Krøyer, Theodor Philipsen, and William Scharff. Denmark's leading sculptor was Bertel Thorvaldsen. His statue of Christ in the Church of Our Lady in Copenhagen is one of his most famous sculptures (see *Thorvaldsen, Bertel*).

The Danish film director Carl Dreyer is regarded as a major figure in cinema history. His film *The Passion of Joan of Arc* (1928) is considered a masterpiece. In recent years, two Danish films have won the Academy Award for best foreign-language film: *Babette's Feast* (1987), directed by Gabriel Axel, and *Pelle the Conqueror* (1988), directed by Bille August.

Outstanding works of Danish design include the silverware of Georg Jensen and the furniture of Kaare Klint and Arne Jacobsen. As an architect, Jacobsen became known for his precise grouping of simple structural elements. Jørn Utzon designed the famous sail-like vaults of the Opera House in Sydney, Australia.

**Recreation.** Soccer is the most popular sport in Denmark. Other favourite sports include bicycling, gymnastics, rowing, sailing, swimming, and tennis. Danes have won Olympic and other world championships in most



Tivoli Gardens is a world-famous amusement park in Copenhagen. Its exotic, lighted grounds attract many visitors at night.



of these sports, and also in archery, boxing, diving, fencing, riding, weightlifting, and wrestling.

Copenhagen is world famous for its Tivoli Gardens amusement park, which opened in 1843 in the heart of the city. The park offers ballet and pantomime, rides and shooting galleries, restaurants, circus acts, concerts, and fireworks displays.

**Social welfare.** Since the 1890's, Denmark has developed many social welfare programmes. The country has insurance schemes that cover accidents, severe injuries, illness, old age, unemployment, and the death of husbands. Any person living in Denmark may join these programmes. Most schemes are managed by private, government-approved organizations, with costs shared by insured persons, employers, and the government. The government manages some schemes, including aid for the aged and for widows, and pays the total cost.

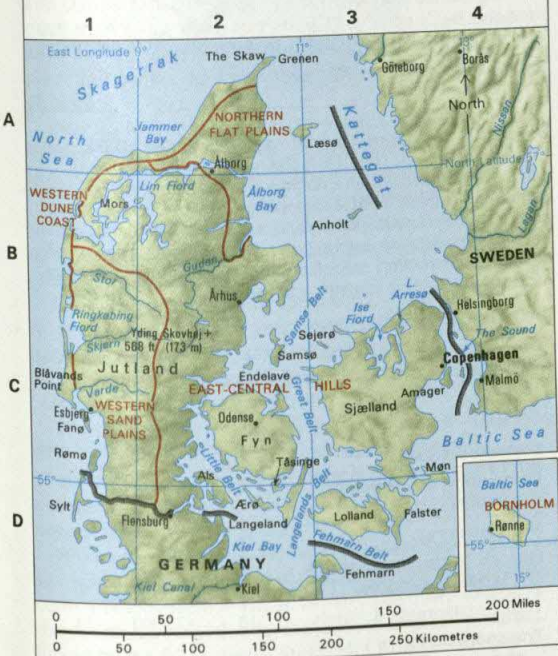
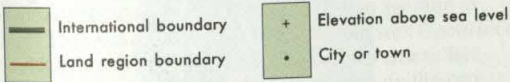
### Land

The peninsula of Jutland accounts for almost 70 per cent of the land in Denmark. However, most Danes live



**The Western Dune Coast** is an area of sandy beaches and dunes that extends along most of Jutland's western coast.

### Denmark terrain map



### Physical features

Ålborg Bay	.....B	2
Als (island)	.....D	2
Baltic Sea	.....C	4
Bornholm (island)	.....D	4
Falster (island)	.....D	3
Fyn (island)	.....C	2
Great Belt (strait)	.....C	3
Guden River	.....B	2
Jutland (peninsula)	.....C	1
Kattegat (channel)	.....A	3
Lake Arresø	.....C	3
Langeland (island)	.....D	2
Langelands Belt (strait)	.....D	2
Lim Fjord	.....A	2
Little Belt (strait)	.....C	2
Lolland (island)	.....D	3
Samsø (island)	.....C	2
Sjælland (island)	.....C	3
Skagerrak (channel)	.....A	1
The Sound (Øresund)	.....C	4
Yding Skovhøj (hill)	.....C	2



**The East-Central Hills**, covering much of Jutland and the nearby islands, have gently rolling lands and narrow fiords.

on about 100 nearby islands. The land is low throughout Denmark. The highest point, the hill of Yding Skovhøj on Jutland, rises only 173 metres above sea level. The land is covered mainly by *moraine*, the riverlike formations of earth and stone deposited by melting glaciers thousands of years ago. The underlying rock can be seen in only a few areas.

**Land regions.** Denmark has five main land regions:

- (1) the Western Dune Coast, (2) the Western Sand Plains, (3) the East-Central Hills, (4) the Northern Flat Plains, and (5) Bornholm.

**The Western Dune Coast** consists chiefly of great sandy beaches that extend along almost the entire western coast. These beaches close off many long, narrow



inlets called *fiords* that once were connected to the sea. In the southwest are marshes that the tide covers regularly.

**The Western Sand Plains** are almost flat. Water from ancient melting glaciers flowed over this region and deposited much sand, forming the plains.

**The East-Central Hills** make up Denmark's largest land region. This gently rolling region includes much of Jutland and almost all the nearby islands. Long, narrow fiords form natural harbours along the coastlines of the region.

The largest inlet is Lim Fiord, which winds across northern Jutland for 180 kilometres. This fiord forms an inland lagoon 24 kilometres wide. A beach on the Western Dune Coast closes off the fiord's outlet to the North Sea. Small vessels use the Thyborøn Canal to travel between Lim Fiord and the sea.

The islands in the region lie close together. Their deep moraine soils are the best farmlands in Denmark. The largest island, Sjælland, is 7,027 square kilometres. Sjælland is the most thickly populated part of Denmark. On this island stands most of Copenhagen, Denmark's capital and largest city. The rest of the city is on the island of Amager. Falster, Fyn, and Lolland are other important islands.

**The Northern Flat Plains** were once a part of the sea bottom. The region rose from the water when the weight of ancient glaciers was removed by melting. Many farms are in this region.

**Bornholm** and nearby small islands lie much closer to southern Sweden than to the rest of Denmark. Granite rock covers most of this region.

**Lakes and rivers.** Denmark has many small lakes. They formed in small hollows left in the ground by melting ice from the glaciers. Lake Arresø, the largest lake, covers 41 square kilometres. Denmark also has many short rivers. The longest one, Guden River, is 158 kilometres long.

### Climate

Denmark has a mild, damp climate, chiefly because it is almost surrounded by water. In winter, seas are not so cold as land, and in summer they are not so warm. As a result, west winds from the seas warm Denmark in winter and cool it in summer. These winds affect Denmark's weather throughout the year. Also in winter, west winds bring some warmth from the North Atlantic Current of the Gulf Stream (see *Gulf Stream*). Denmark is small, so the climate does not differ much from area to area.

Winter temperatures average about 0°C in Denmark, with the coldest days from -9 to -7°C. The waters on the east may freeze over during especially cold winters. At these times, the waters cannot warm the cold winds and the weather may become bitterly cold. Summer temperatures average 17°C. The warmest weather usually varies from 24 to 28°C. Winds from eastern Europe may cause higher temperatures in especially hot summers.

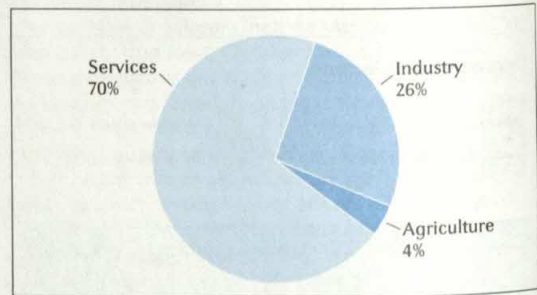
Denmark receives a yearly average of about 61 centimetres of *precipitation* (rain, melted snow, and other forms of moisture). Western Denmark gets a little more precipitation than eastern Denmark because the moisture-bearing west winds reach it first. Rain falls throughout the year, with the most during August and

October. Snow falls from 20 to 30 days a year, but usually melts quickly. Fog and mist occur frequently, especially on the west coast in winter.

### Economy

Denmark has a strong economy, even though the country is poor in natural resources. Denmark obtains some natural gas and petroleum from wells in the North Sea. However, it still must import petroleum. Other mineral products of Denmark include chalk and industrial clays. Coal, as well as iron and most other metals, must be imported. Much of the soil in Denmark lacks nutrients, so it requires heavy use of fertilizers to make it productive. The land is flat or gently rolling, so the rivers cannot be used to generate hydroelectric power. Forests cover only about a tenth of the land and supply less than half of Denmark's wood. The seas that almost surround the country provide an inexpensive means of

### Denmark's gross domestic product



Denmark's gross domestic product (GDP) was 130,285,000,000 U.S. dollars in 1991. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, property, and business services; trade, restaurants, and hotels; transportation and communication; and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, forestry, and fishing.

### Production and workers by economic activities

Economic activities	Per cent of GDP produced	Employed workers Number of people	Per cent of total
Community, government, & personal services	27	1,352,000	36
Manufacturing	19	586,400	20
Finance, insurance, property, & business services	19	252,700	9
Trade, restaurants, & hotels	13	422,700	14
Transportation & communication	9	194,600	7
Construction	6	199,300	7
Agriculture, forestry, & fishing	4	160,600	6
Utilities	2	19,800	1
Mining	1	3,200	†
Total	100	3,191,300	100

†Less than one-half of 1 per cent.

Figures are for 1991.

Sources: International Labour Organization; Statistics Denmark.



transportation by which Denmark can import its industrial needs and export its products. The seas are also rich in fish.

**Service industries** employ more than two-thirds of the Danish labour force. Service industries are those economic activities that produce services, not goods. They include schools, hospitals, shops, hotels, restaurants, and government services. Banking, insurance, property, transportation, and communication are also service industries.

**Manufacturing** in Denmark has expanded rapidly since the mid-1900's and has replaced agriculture as the nation's second largest economic activity. The government has done much to promote manufacturing by expanding educational programmes to train engineers, technicians, and skilled workers.

Nearly half of all Danish manufacturing is concentrated in the Copenhagen area. Danish factories produce high-quality goods, including stereos, television sets, furniture, porcelain, and silverware. Among Denmark's other products are diesel engines, machinery, pharmaceuticals, ships, textiles and clothing, and processed foods, which include bacon, butter, cheese, ham, and beer.

**Agriculture.** Farmland makes up about two-thirds of Denmark's total land area. Farms cover an average of about 40 hectares. Until the 1880's, wheat was Denmark's most important farm product. Then wheat prices fell, and Danish farmers began to concentrate on the production of eggs, pigs, and milk. They organized cooperative dairies and slaughterhouses, and shared equipment and profits. Today, cooperatives cover all branches of farming.

Rearing pigs and beef or dairy cattle is the major activity on most Danish farms. Most crops are used for livestock feed. They include barley, potatoes, sugar beet, and *rape* (a leafy herb). Barley is grown on more of the nation's farmland than any other crop. About 60 per cent of the country's farm production is exported as meat and dairy products.

**Fishing.** Danish fishing ships catch about 2 million metric tons of fish each year. Important fish include cod, herring, Norway pout, sand lances, sprat, and whiting. More than half the catch is taken from the North Sea. Esbjerg is Denmark's major fishing port.

**Transportation.** Denmark has an excellent road system. There are about 1 1/2 million cars in Denmark, or about one car for every four people. At least half of the people use bicycles for transportation, and many roads have separate bicycle lanes.

A government-owned railway provides fast passenger service to most cities and towns. Train-carrying ferries connect many Danish islands with each other and with the mainland. The islands of Sjælland and Falster are linked by the 3,211-metre Storstrøm Bridge.

Denmark has many busy seaports, of which Copenhagen is the most important. Kastrup Airport, near Copenhagen, is one of Europe's largest air terminals. It handles about 12 million passengers a year.

**Communication.** Denmark has about 50 daily newspapers. The largest dailies include the *Berlingske Tidende*, *B.T.*, *Ekstra Bladet*, and *Politiken*, all of Copenhagen.

Almost all Danish families own at least one radio and



**Danish electronic products** are known for their high quality and attractive design. This photograph shows a Danish factory worker assembling a television set.

one television set. All radio and television broadcasting is handled by Radio Denmark, a public organization responsible to the Danish Ministry of Cultural Affairs. No advertising is allowed on the programmes. The Danish people pay a yearly licence fee for each radio and television set.

The government owns and operates the Danish telegraph system and long-distance telephone service. Most local telephone service is privately owned.

### History

**Early days.** As long as 100,000 years ago, people lived in what is now Denmark. Great changes in the climate occurred, and the region became too cold for human life. The climate started to become warmer about 14,000 years ago, and continuous settlement began. Farming developed in the region about 3,000 B.C.

By the time of Christ, trade by sea had brought the people into close contact with leading civilizations. The contact expanded for hundreds of years. During this period, the Danes lived in small communities governed by local chieftains. About A.D. 950, all Denmark was united by King Harald Bluetooth. Harald fostered the spread of Christianity in Denmark.

About 800, Danish seafarers began raiding European coastal towns and sailing away with slaves and treasure. The Danish Vikings spread terror throughout much of western Europe for about 300 years. The Vikings gained control of England in 1016, with the result that Danish kings ruled that country until 1042. See **Vikings** (The Danish Vikings).

**A great power.** During the late 1100's and early 1200's, Danish power expanded along the southern coast of the Baltic Sea to Estonia, which Denmark conquered in 1219. But a long period of civil wars and struggles with north German cities, beginning in the 1240's, greatly weakened the country.

Denmark regained its power under Queen Margaret, who became ruler of Denmark as regent for her young son in 1375. Margaret was also the wife of King Haakon VI of Norway. After he died in 1380, Margaret became





A sculpture adorns the tomb of Queen Margaret, who united Denmark, Norway, and Sweden in the Union of Kalmar in 1397. Under her skilful leadership, Scandinavia enjoyed 20 years of peace and economic growth.

regent of Norway as well as Denmark. In 1388, during political confusion in Sweden, Swedish nobles elected her to rule that country, too. In 1397, Margaret united Denmark, Norway, and Sweden in the Union of Kalmar, with power centred in Denmark. Sweden broke away from the union in 1523.

In 1536, during the Reformation, King Christian III established Lutheranism as the official religion of Denmark. That same year, Christian made Norway a province of Denmark.

**Wars with Sweden.** During the 1600's and 1700's, Sweden defeated Denmark in several wars fought for control of the Baltic Sea. During the Danish-Swedish War (1657-1660), Sweden won a great deal of Danish and Norwegian territory in what is now Sweden. Only pressure from England, France, and the Netherlands prevented Sweden from dividing Denmark itself. In the Great Northern War (1700-1721), Denmark tried unsuccessfully to win back the territory it had lost to Sweden.

In 1788, Denmark began freeing its serfs. These peas-

ants had been bound to the land on which they worked. Educational reforms were begun during the early 1800's. Denmark sided with France in the Napoleonic Wars of that period and was defeated by Sweden in 1813. By the terms of the Treaty of Kiel in 1814, Denmark gave Norway to Sweden but kept Greenland and other Norwegian colonies.

**The Schleswig wars.** In 1848, the pressure of public opinion forced King Frederik VII to accept a democratic constitution for Denmark. The constitution was adopted in 1849. It granted the highest power of government to an elected two-house parliament.

Also in 1848, a revolt broke out in Holstein and Schleswig, two Danish duchies that were located just south of Denmark. These regions were ruled by the Danish king, though they were not part of Denmark. A revolutionary government of Schleswig-Holstein was established. This government wanted to throw off Danish control and join the German Confederation, of which Holstein was already a member. Danish troops defeated the rebels in 1850. In 1863, Schleswig was made a part of Denmark. Prussia and its ally, Austria, invaded Denmark in 1864. They won a quick victory and took over Schleswig and Holstein.

**Social and political reforms.** During the late 1800's, education, industry, and trade were expanded in Denmark. The Danes also developed cooperatives and improved their farming methods. At this time, the upper classes had special rights that gave them control of the upper house of the parliament. The small farmers and industrial workers formed political parties and struggled for political equality. A new constitution was adopted in 1915 during the reign of Christian X, who served as king from 1912 to 1947. By the terms of the constitution, the special rights of the upper classes were abolished, and Denmark became a parliamentary democracy.

Denmark remained neutral during World War I (1914-1918). After the war, Denmark granted independence to Iceland, a Danish colony. However, Iceland stayed united with Denmark until 1944, when it became a republic. In 1920, the Allies transferred North Schleswig to Denmark from Germany. Most people of the region had voted for the transfer.

**World War II** began in 1939. On April 9, 1940, German forces invaded Denmark, and the Danes surrendered after a few hours of fighting. The Germans allowed the Danish government to continue as long as it met their demands. But resistance groups developed and blew up factories and transportation facilities. The

### Important dates in Denmark

- c. 950** King Harald Bluetooth united Denmark and encouraged the spread of Christianity in the country.
- 1013-1042** Denmark ruled England.
- 1380** Denmark and Norway were united under Queen Margaret.
- 1388** Queen Margaret was elected ruler of Sweden as well.
- 1397** Denmark, Norway, and Sweden were united in the Union of Kalmar.
- 1536** Lutheranism became the official Danish religion.
- 1657-1660** Denmark lost much territory to Sweden in the Danish-Swedish War.
- 1788** The government began freeing the Danish serfs.
- 1814** Denmark lost Norway to Sweden in the Napoleonic Wars.
- 1849** Denmark adopted its first democratic constitution.
- 1864** Denmark lost Schleswig and Holstein to Prussia and Austria.
- 1918** Denmark granted independence to Iceland, which remained under the Danish king until 1944.
- 1920** North Schleswig was returned to Denmark.
- 1940-1945** Germany occupied Denmark during World War II.
- 1944** Iceland ended its union with Denmark.
- 1949** Denmark and 11 other nations formed the North Atlantic Treaty Organization (NATO).
- 1953** Denmark adopted a new constitution that ended the upper house of parliament.
- 1960** Denmark and six other countries formed the European Free Trade Association (EFTA).
- 1973** Denmark became a member of the European Community, now known as the European Union.
- 1982** A Conservative-led coalition government replaced the government of the Social Democrats.



Germans took over the government of Denmark in August 1943.

In September 1943, the Danes organized the secret Freedom Council to lead the resistance movement. They also helped about 7,000 Danish Jews escape to Sweden. On May 5, 1945, after the fall of Germany, Allied troops entered Denmark and the Germans there surrendered. See **World War II**.

Denmark became a charter member of the United Nations in 1945 and of the North Atlantic Treaty Organization (NATO) in 1949. During the late 1940s, the United States gave Denmark much aid. The Danes rebuilt industries that had been damaged during the war, and the nation's economy became strong again.

**Postwar years.** Political reform and economic expansion in Denmark continued during the 1950s and 1960s. In 1953, a majority of Danish voters approved a new constitution that abolished the upper house of parliament. The constitution also made Greenland a province of Denmark, rather than a colony. In addition, Danish voters approved a law that permitted both males and females to inherit the throne.

In 1960, Denmark and six other European countries, including Norway, Sweden, and the United Kingdom, formed the European Free Trade Association (EFTA). The EFTA regulates and promotes trade among its members (see **European Free Trade Association**). Denmark resigned from the EFTA in 1972, and in 1973, entered the European Community (EC), now known as the European Union, an economic association of Western European nations that began in 1957 (see **European Union**).

In 1966, Denmark launched a massive economic development programme in Greenland. The programme called for the expansion and modernization of Greenland's towns and of its fishing and food-processing industries. In 1979, the Danish parliament granted *home rule*—that is, the power of local self-government—to Greenland.

King Frederik IX died in 1972. His oldest daughter, Margrethe, succeeded him on the throne.

**Recent developments.** During the 1970s and early 1980s, Denmark—like many countries—faced an economic recession. In 1982, a Conservative-led coalition government replaced the government of the Social Democrats. This centre-right coalition worked to encourage economic recovery, but Denmark still faced problems of environmental pollution, unemployment, and the high cost of welfare services. Eventually, the centre-right coalition was brought down in 1993, not by the economic situation, but by a political scandal. It was replaced by a centre-left coalition led by the Social Democrats once more.

In 1991, the Danish government and other EC members signed a major treaty on European union at Maastricht, the Netherlands. The treaty required *ratification* (confirmation) by all EC states, through legislation or referendum, before it could come into effect. In 1992, Danish voters in a referendum rejected the treaty. In a summit held later in Edinburgh, Scotland, the Danes secured exemption from certain parts of the treaty. In June 1993, another vote showed 56.8 per cent of the Danish people accepted the treaty, with 43.2 per cent against. Outbreaks of rioting followed the announcement of this result. Eventually, all EC member nations

ratified the Maastricht Treaty and the EC became known as the European Union in 1993.

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Brahe, Tycho	Margrethe II
Bruhn, Erik	Nielsen, Carl A.
Canute	Oersted, Hans C.
Christian IV	Thorvaldsen, Bertel
Christian IX	

#### History

Anglo-Saxons	Seven Weeks' War
Europe, Council of	Sweden (History)
European Union	Vikings
Jutes	World War II
Norway (History)	

#### Physical features

Baltic Sea  
Faroe Islands  
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Skagerrak

#### Other related articles

Århus  
Copenhagen  
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Iceland  
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Scandinavia  
Theatre (Scandinavia)  
Virgin Islands of the United States

#### Outline

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| B. Courts                  |                          |
| C. Local government        |                          |
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| A. Population and ancestry |                          |
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| D. Religion                |                          |
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| <b>VI. Economy</b>         | D. Fishing               |
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| B. Manufacturing           | F. Communication         |
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| <b>VI. History</b>         |                          |

#### Questions

- What do Denmark's folk secondary schools offer students?
- What is Denmark's official church?
- What is the major farm activity in Denmark?
- Which area has about a quarter of Denmark's total population and almost half the country's manufacturing industries?
- What does the *ombudsman* do?
- How did Denmark, Norway, and Sweden become united during the late 1300s?
- Why can Denmark's rivers not generate hydroelectricity?
- How is the Danish broadcasting system supported?
- Who united Denmark? When?
- Who is known as the father of modern Danish literature?



**Denning, Lord** (1899– ), a distinguished British judge, was Master of the Rolls from 1962 to 1982. He became known for his many controversial legal decisions upholding justice for the individual. These decisions often went against existing case law.

Alfred Thompson Denning was born at Whitchurch, Hampshire. He was educated at Oxford University and called to the Bar in 1923. He became a judge of the High Court in 1944. In 1957, he became a life peer and sat as one of the Law Lords.

**Dennis, C. J.** (1876–1938), called the *Laureate of the Larrikin*, was considered one of the most humorous and witty of Australian poets. He was mainly popular for ballads written with great vigour and humour in the *larrikin* (young hoodlum) language. The most popular of these ballads were *The Songs of a Sentimental Bloke* (1915) and *The Moods of Ginger Mick* (1916). The ballad sequence of *The Sentimental Bloke* is a real human story of the Bloke's life. *The Moods of Ginger Mick* is in the same humorous poetic style, and relates the adventures of the Bloke's mate Ginger as a *digger* (Australian soldier).



C. J. Dennis

Dennis has been accused of sloppy sentimentality and of caricaturing the characters of the larrikins and diggers in his verses so that he perpetuated a popular belief that the real Australian of the period acted, thought, and spoke like his characters. But Dennis was a skilled versemaker. His descriptions are hilarious, his backgrounds are convincing, and his characters, with their racy speech, are endearing. Above all, he had a clever command and control of both the real and his invented Australian slang.

Dennis also wrote some poems for children in *A Book for Kids* (1921). He wrote a little serious verse, which is lyrical and pleasing. The most popular is *The Singing Garden* (1935), a collection of prose and poetry on nature themes. He also wrote some easy satire in his journalistic work and in *The Glugs of Gosh* (1917), a burlesque of middle-class society. But his literary importance lies in his unique larrikin verse. *The Sentimental Bloke* has been the subject of a musical comedy and two films.

Dennis was born at Auburn in South Australia and named Clarence Michael James Dennis.

**Denominate number** tells the amount of a quantity by giving the number of units and the kind of units that make up the quantity. A denominate number includes a number, which may be written as a numeral or as a word, and the name or symbol of a unit of measurement. For example, *six metres*, *90 pounds*, *7.51 dollars*, *18 kilometres*, *23° C*, and *four days* are all denominate numbers. See also **Unit**.

**Denominator.** See **Fraction** (In symbols); **Arithmetic** (Working with fractions).

**Density** is the *mass*—that is, the amount of matter—in a unit volume of any substance. The density of a sub-

stance is found by dividing its mass by its volume. The density of a liquid or solid is measured in grams per millilitre. The density of a gas is measured in grams per litre. The equation for density is:

$$\text{Density} = \text{mass} \div \text{volume, or } d = m/V.$$

The concentration of a substance in a solution can be determined by measuring the density of the solution. Density measurements are useful in identifying minerals and other solids. In addition, the *molecular weight* of a gas can be calculated from its density (see **Molecule** (Individual molecules)).

The density of a liquid can be determined by measuring the mass needed to fill a container of a known volume. In most cases, a device called a *pycnometer*, which has a precisely known volume, is used for this purpose. An instrument called a *hydrometer* is also used to determine the density of a liquid (see **Hydrometer**).

The density of a regularly shaped solid is determined by simply measuring the object's mass, calculating its volume, and dividing the mass by the volume. The density of an irregularly shaped solid is determined by submerging it in a known quantity of liquid and measuring the volume of the liquid displaced. The volume of the displaced liquid equals the volume of the solid. The mass of the object is then determined and is divided by the volume.

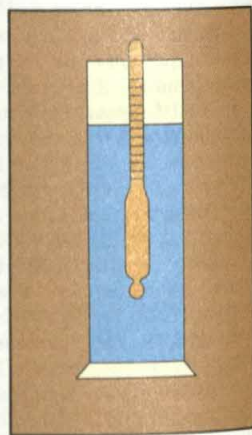
The density of a gas is difficult to measure because it is extremely low and changes greatly with variations in temperature and pressure. The mass of a gas can be determined by subtracting the mass of an empty container from the mass of the same container when filled with the gas. The volume of the container can simply be found by measuring the amount of water (using a graduated flask) that the container holds.

The *specific gravity* of a substance is related to its density. Specific gravity is the ratio of the mass of a given volume of the substance to the mass of an equal volume of water. It is found by dividing the density of the substance by the density of water at either 4° C or 20° C.

For the density of all the elements, see **Element, Chemical** (table).

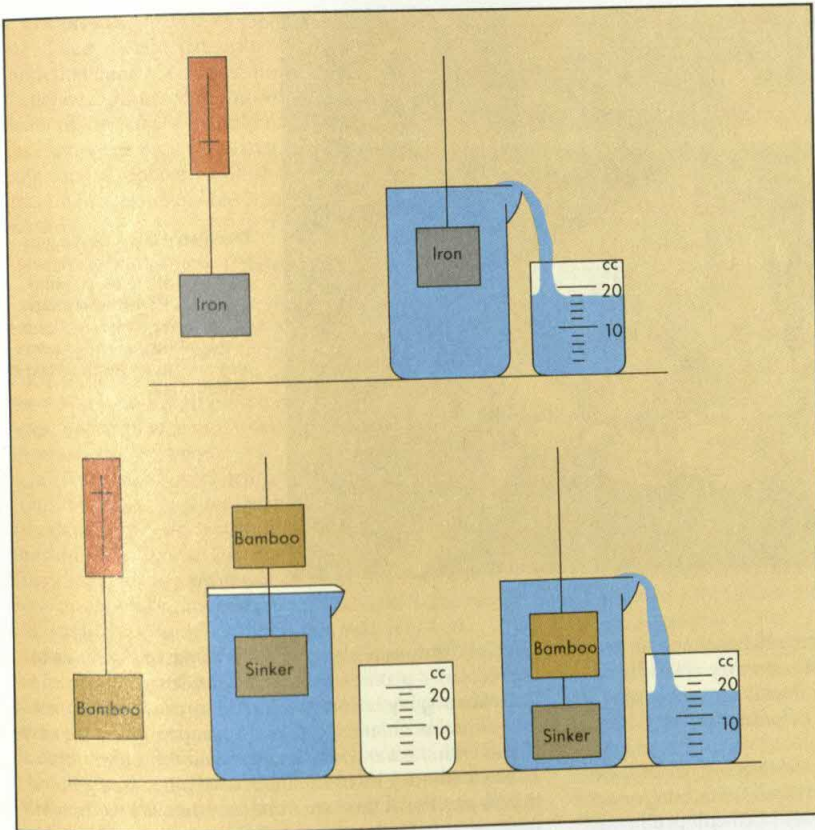
**Density of population.** See **Population** (World population); **World** (People of the world).

**Dental hygiene** is the science and practice of caring for the teeth, gums, and other parts of the mouth. Good mouth hygiene prevents dental decay, gum disease, and other oral conditions (see **Teeth** (Diseases of)). It is also the best way to minimize the need for dental treatment, such as fillings or even extractions. In most developed



The density of a liquid can be determined with a hydrometer. This device is placed in the liquid and allowed to sink. How deep it sinks indicates density.





The density of a solid is determined by measuring the object's mass, calculating its volume, and dividing the mass by the volume. The volume can be determined by submerging the object in water, *top left*. The object's volume is equal to the volume of the water that overflows. When this method is used for a solid that floats, *bottom left*, a sinker is attached to the object to submerge it. The volume of the sinker is then subtracted from the total volume of water displaced, to determine the object's volume.

countries, dental hygienists are trained to help children and adults maintain good oral health.

**What dental hygienists do.** The dental hygienist cleans and polishes the teeth, and gives instruction in proper care of the mouth. The hygienist may also apply fluoride and plastic sealants to help prevent tooth decay.

**Education.** In many countries, dental hygienists are taught dental hygiene within dental schools. Applicants have appropriate certificates of general or technical education. Courses last about a year, and lead to a Certificate of proficiency in dental hygiene. Subjects studied include basic and oral sciences, dental health education and practical skills in dental hygiene.

Dental hygienists may train further to become dental therapists. Dental therapists can take X rays of the mouth, place fillings in *deciduous* (milk) teeth and simple fillings in permanent teeth.

**Dentistry** is the art and science of diagnosing, treating, and preventing diseases of the teeth, jaws, and surrounding soft tissues of the mouth. Dentists care for their patients in many ways, but mainly through their skill at recognizing, correcting, and preventing problems of the teeth and the tissues that support the teeth. Dentists also may take on the role of dental hygienists. For example, they may recommend the correct way to brush the teeth to keep them healthy.

Dental treatment includes a wide range of dental services. Some of these services focus on correcting problems of the teeth caused chiefly by dental decay.

Such treatment, called *restoration*, often involves the use of some kind of dental filling. Other dental services deal with the prevention and treatment of diseases of the teeth and their supporting tissues. Still others concentrate on the position of the teeth in relation to each other and to the jawbones. Sometimes teeth require removal. This process, usually performed using an *anesthetic* (painkilling drug), is called *extraction*. Dentists may also treat injuries, infections, tumours, and various other conditions of the teeth, jawbones, and related tissues.

Dentistry is practised in dental surgeries where one or a number of dentists treat patients. Dental schools, in addition to training future dentists, also conduct research. This research provides improvements in the diagnosis and treatment of dental disorders. In addition, dentistry is practised in large clinics, in hospitals, and in dental schools.

### Branches of dentistry

A number of branches of dentistry have been established. They include (1) general dentistry, (2) orthodontics, (3) oral surgery, (4) periodontics, (5) dental prosthetics and prosthodontics, (6) oral pathology, (7) paediatric dentistry, and (8) endodontics.

**General dentistry** involves all phases of dental practice. Much dental practice is concerned with the prevention of mouth diseases. Dentists teach patients techniques for cleaning teeth correctly at home. They help





**Dentistry** involves diagnosing, treating, and preventing diseases of the teeth, gums, and jaws. Regular checkups are part of good dental care. In this photo, a dentist examines a patient's teeth during a routine visit.

patients establish nutritious eating habits that help keep teeth and gums healthy. Dentists also may clean the patient's teeth and gums. In many dental surgeries, specially trained *dental hygienists* help dentists with these activities (see **Dental hygiene**).

General dental treatment includes filling cavities, extracting teeth, and replacing lost teeth with *bridges* or *dentures* (see **Teeth** [Dental decay]). Difficult problems are sometimes cared for by specialists in other branches of dentistry.

**Orthodontics** specializes in the correction and prevention of irregularities of the position of teeth. These irregularities usually happen as the teeth grow during early childhood and may produce *malocclusion* (bad bite). The majority of malocclusions occur because the teeth are too large for the amount of jaw space available. As a result, the teeth become crowded. Orthodontists correct malocclusions with braces or other mechanical devices that move the teeth into a better

position. They may also use orthodontic techniques to correct facial profiles. See **Orthodontics**.

**Oral surgery** is concerned with the surgical correction of oral problems. Many of these problems are associated with the *third molars*, also called *wisdom teeth*. These teeth may be too difficult to remove in a general dental practice if they are *impacted* (heavily wedged) in the jawbone. Oral surgeons remove tumours and cysts from the mouth and treat fractures of the teeth and jaws caused by injuries. They also correct cosmetic problems of the jaws and face, using methods similar to plastic surgery.

**Periodontics** deals with diseases of the tooth-supporting tissues—the bones surrounding the teeth, the *ligaments* between bones and teeth, and the gum tissue. Periodontal diseases are responsible for more tooth loss in adults than any other dental problem. These diseases can be prevented by proper home dental care.

**Dental prosthetics and prosthodontics** deals with the replacement of missing or damaged teeth. Replacement often involves the construction of complete or partial dentures, which are removable devices. Sometimes missing teeth are replaced by bridgework cemented to the remaining teeth. Replacements are made of plastic, porcelain, gold or other metals, or combinations of these materials.

**Oral pathology** deals mainly with the diagnosis of mouth diseases using laboratory procedures. Soft or hard tissues from the patient's mouth may be examined with the aid of a microscope to identify tumours or other disorders. Some oral pathologists also specialize in *forensic dentistry*, which applies oral pathology to legal cases. These specialists are frequently called upon to identify dead people by comparing dental records with the teeth and tissues of the deceased.

**Paediatric dentistry** specializes in the dental problems of children and also concerns other special patients, such as adults who have physical disabilities.



**Braces for teeth** consist of metal bands connected by wires and, sometimes, small rubber bands. Orthodontists use braces to correct irregular positioning of the teeth and jaws.



**Endodontics** involves diagnosis and treatment of diseased dental *pulp*. The pulp is the central portion of the tooth that contains nerves and blood vessels. Severe dental decay and other injuries may cause infection or death of the pulp. This pulp can be removed by a process known as *root canal treatment*. Once removed, the pulp can be replaced with special filling material. Such treatment saves many teeth that would otherwise be extracted.

## History

**Early dentistry.** Human beings have always experienced dental problems. The ancient Greeks, Romans, and Egyptians used various remedies for toothaches, including tooth extraction. People in early civilizations even developed gold dental bridges. In the Middle Ages, dentistry was practised by such craftworkers as jewellers and barbers.

In 1728, Pierre Fauchard, a French dental scientist, published *The Surgeon Dentist*. This book detailed complex dental devices, instruments, and methods and is considered a landmark in the history of dentistry. Dentistry emerged as a profession in the mid-1800's. At this time, the dental condition of many people in the newly industrialized countries like Britain was very bad.

**Modern dentistry** began during the mid-1800's with the introduction of *general anaesthetics* to relieve discomfort during dental procedures. General anaesthetics make patients unconscious and unable to feel pain throughout the body. Nitrous oxide was first used as a general anaesthetic by an American dentist, Horace Wells, in 1844. Two years later, another American dentist, W. T. G. Morton, gave the first formal demonstration of the use of ether as an anaesthetic (see **Morton, William T. G.**).

In 1884, an American doctor William Halsted used cocaine to block pain sensations in the lower jaw. Cocaine was the first *local anaesthetic*—that is, a drug that blocks pain in only part of the body and does not cause unconsciousness.

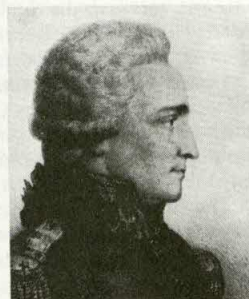
By the early 1900's, the use of dental drills had be-

come widespread. In addition, principles for filling cavities had been established through the work of an American dentist, G. V. Black. These important developments, along with the discovery of X rays in 1895 and the use of silver filling materials, helped revolutionize dentistry.

Since the 1950's, the addition of *fluorides* to water supplies and toothpastes has greatly reduced tooth decay (see **Fluoridation**). The development of high-speed dental drills has simplified dental procedures and the widespread use of local anaesthetics has made them painless. In addition, the development of plastic filling materials has made it possible for dentists to cover up unsightly discolorations, cracks, or gaps in teeth.

**D'Entrecasteaux, Bruni** (1739-1793), a French naval commander, explored much of southern Australia. Joseph Antoine Bruni

D'Entrecasteaux was born at Aix-en-Provence, in France. After commanding the French naval squadron in the East Indies, he led the expedition sent by the French revolutionary government in 1791 to find the missing explorer La Perouse. Accompanied by scientists, D'Entrecasteaux combined his search with a scientific survey of Australia and the South Pacific. He surveyed the south



**Bruni D'Entrecasteaux**

coast of Western Australia from Cape Leeuwin to the Head of the Bight and made a detailed survey of the east coast of Tasmania, discovering D'Entrecasteaux Channel. Further north, he surveyed the islands of the West Pacific close to New Guinea.

**Denver** (pop. 467,610; metropolitan area pop. 1,622,980) is the capital of the Rocky Mountain state of Colorado in the United States. The city serves as the distribution, manufacturing, and transportation centre for the part of the U.S.A. known as the Rocky Mountain region. People refer to Denver as *The Mile High City* because the Capitol stands on land 1 mile (1.6 kilometres) above sea level.

Denver covers 295 square kilometres. It lies on the South Platte River, 16 kilometres east of the Rocky Mountains. For location, see **United States of America** (political map).

Denver's main business district includes 17th Street, a financial centre lined with banks and investment firms. Central Denver has a pedestrian mall which is 14 blocks (about two kilometres) long, and high-rise apartment buildings (living accommodation). Southeast of the main business district, the Civic Center includes the City and County Building, the Colorado State Capitol, and the Denver Art Museum. The City Auditorium and Theater and the Denver Coliseum stand west of the business district.

Denver's art museum, public library, symphony orchestra, and summer theatre all contribute to the city's cultural life. The Denver Broncos American football team and Denver Nuggets basketball team are professional sports organizations in the city. Denver is a central point for winter sports and serves as a gateway to



**A travelling tooth-puller**, like the one shown above, was one of many untrained people who practised dentistry in the 1700's. Dentistry became a recognized profession during the 1800's.



mountain tourist areas. The city owns Winter Park ski resort.

**Economy.** More people work for the U.S. federal or state governments than for any other employer. Denver is the national or regional headquarters of more federal agencies than any other U.S. city except Washington, D.C. The Denver mint makes millions of coins every year.

The Denver metropolitan area has many manufacturing plants. Food processing ranks as the city's chief manufacturing activity. Other Denver products include defence, high-technology, and transportation equipment. The Denver Union Stockyards are one of the major U.S. livestock centres.

A large number of warehouses help make Denver the distribution centre of the Rocky Mountain region. The city also serves as the region's transportation centre. Many commercial airlines use Stapleton Airport, one of the world's busiest airports.

**History.** Denver was founded in 1858, after prospectors found gold at Cherry Creek. A gold rush took place the next year, and the community became a supply point for mining settlements. Denver was incorporated as a city in 1861.

The city expanded with completion of the Denver Pacific Railroad in 1870. A silver-mining boom provided additional wealth during the 1880's and 1890's.

By 1910, Denver had become a regional centre of commerce. The Moffat Tunnel, a mountain railway route from Denver through James Peak, was completed in 1927.

During the 1970's, Denver faced the problem of preserving its natural beauty while expanding its industry. The city made efforts to reduce air pollution and industrial pollution on the South Platte River.

From 1968 to 1985, the Denver Urban Renewal Authority's Skyline Project replaced and restored run-down buildings in the city centre. The Denver Technological Center (DTC), an office park southeast of the city, is the home of hundreds of companies. Denver has a mayor-council form of government.

**Deodorant** is a consumer product or an ingredient designed to reduce, prevent, or cover up unpleasant body odours. Most external body odour occurs when bacteria react with perspiration and secretions on the skin. Perspiration itself has no odour. Deodorants generally contain chemicals that stop the growth of bacteria. Many deodorants contain a fragrance that masks odour. Some deodorants called *antiperspirants* also reduce the amount of perspiration.

The word *deodorant* is most frequently associated with personal products that act against underarm odour. However, deodorants are also made for the feet and genital area, and to reduce odours from surgical openings and other disorders. Deodorants and antiperspirants are manufactured in the form of creams, roll-on liquids or lotions, sticks, and sprays. Common antibacterial ingredients in deodorants include zinc or magnesium salts, benzethonium chloride, and triclosan. Aluminium, zirconium, or aluminium-zirconium compounds in most antiperspirants act to reduce perspiration.

Until 1972, the most common antibacterial ingredient in deodorants and antiperspirants was a chemical called

*hexachlorophene*. The United States Food and Drug Administration (FDA) restricted its use in cosmetics after research showed that it could damage the nervous system.

**Deodorizer** is a substance or device that eliminates or reduces disagreeable odours. Such odours are sometimes called *malodours*.

Most deodorizers are *masking deodorizers*, which emit fragrances to cover malodours. Masking deodorizers include incense, scented candles, fragrant sprays, and fragrant gels. Deodorizers called *disinfectants* are applied to surfaces on which bacteria that cause malodours live. The disinfectants eliminate odour by killing the bacteria. Many disinfectants also contain a fragrance. *Chemical deodorizers*, such as the chemical compounds *potassium permanganate* and *hydrogen peroxide*, eliminate malodours by means of *oxidation*. In this process, oxygen from the chemical deodorizers eliminates the odours by combining with the chemicals that cause the odours.

To eliminate malodours in large buildings, *mechanical deodorizers* are typically used. Most mechanical deodorizers are *air cleaners*. These devices remove from the air impurities that cause malodours. The air is drawn through the devices by means of fans. In air cleaners called *electrostatic precipitators*, wires in the device give a positive electric charge to airborne particles that cause malodours. The positively charged particles are then captured on negatively charged metal plates in the device. Some other air cleaners use a *scrubbing* process. In one form of scrubbing, air that contains malodorous particles is forced through water or some other liquid. The particles dissolve in the liquid and thus are removed from the air. See *Air cleaner*.

**Deoxyribonucleic acid.** See *Nucleic acid*.

**De Palma, Ralph** (1883-1956), was a pioneer American racing driver. He won the Indianapolis Speedway 805-kilometre race in 1915 and the national driving title in 1912 and 1914. De Palma set a world record of 241.2 kph in 1919. He claimed 2,557 victories in 2,889 races. Many of these were match races against another driver, rather than open competition. De Palma was born in Italy.

**Department store** is a large store that sells many kinds of goods in separate departments under one management. It also provides a variety of services. Most department stores occupy a single building and cover at least two floors. In a typical department store, perfumes, jewellery, and similar articles are located on the ground floor, and clothing, furniture and appliances are on the upper floors.

A typical department store is organized into five divisions: *merchandising*, *operations*, *promotion*, *finance*, and *personnel*. Merchandising involves the buying of merchandise for the store and the selling of it to customers. Operations includes security, customer service, maintenance, and general housekeeping. Promotion deals with advertising and displaying merchandise, and with public relations. Finance covers accounting, credit management, and similar financial matters. Personnel deals with the hiring and training of employees and the keeping of certain records on them.

Many historians believe that Aristide Boucicaut, a French merchant, established the first department store.



Boucicaut managed a store in Paris called *Bon Marché* (French for *good bargain*). Bon Marché originally sold only fabrics, but in the 1850's, it began to sell a large variety of goods, arranged by department.

Boucicaut's retailing practices were quickly copied by such American businessmen as Marshall Field, Eben Jordan, Rowland H. Macy, Benjamin L. Marsh, Alexander T. Stewart, and John Wanamaker. By the early 1900's, department stores had spread throughout the United States and Europe.

Early department stores differed from those of today in a number of ways. For example, the first department stores were established in central shopping areas, but many are now located in out-of-town shopping centres. The early department stores were one-store operations. Many department stores were family businesses, occupying the best positions in high streets. Most of them have now been taken over by large retail groups which can often run them more profitably. Originally, department stores provided a high level of personal service to their customers in all departments. For this reason, their major appeal was to middle income groups. Many modern stores, however, have some departments that are largely self-service. The first department stores occupied several storeys and offered a great variety of merchandise. Today's newer department stores occupy only a few floors and sell a smaller variety of goods.

**Depilatory.** See Hair (Disorders).

**Deportation** is the action a government takes when it forces an alien to leave the country and return to the place where the alien was born or had lived. A government may deport an alien because the person entered the country illegally, or because it is believed he or she may harm the nation's interests in some way. This may be because the person has committed a serious crime.

**Deposit**, in geology. See Coal (Where coal is found); Rock (Sedimentary rock).

**Deposition**, in law, is the testimony of a witness who does not appear in court. The witness testifies under

oath before a judicial officer. The witness does not appear in court either because he or she is unable to, or both sides have agreed that there is no need for the witness to appear. The deposition may be merely a witness's statement or it may contain answers to questions put by both parties to the legal proceedings. A deposition differs from an *affidavit*, which is a one-sided statement of fact given in court voluntarily under oath (see *Affidavit*).

**Depreciation** is the loss of value. Buildings, machines, vehicles, and other property *depreciate* (lose value) through use or accident, because they grow older, or because a new, better product replaces them. In accounting, depreciation is calculated as a normal cost of doing business. The term *depreciation* is also used to describe the loss of value or purchasing power resulting from an increase in the level of domestic prices. In this sense, the term refers to the currency of a country becoming lower in value relative to currencies of other countries. See also **National income** (Determining national income).

**Depressant** is a drug that slows the activity of the nervous system. Doctors prescribe depressants to ease pain, induce sleep, or reduce tension. Many depressants are either habit-forming or addictive. If a person takes such a depressant daily for several weeks, a physical or psychological dependence on it may develop. An overdose of a depressant can be fatal.

Major types of depressants include alcohol, anaesthetics, sedatives, and tranquillizers. Alcohol reduces most brain functions. Anaesthetics, the most powerful painkillers, are used during surgery. Sedatives calm a patient or bring on sleep. The first substance used as a sedative was a solution of bromide salt. Such sedatives as barbiturates depress the central nervous system. Tranquillizers lessen tension without decreasing mental or physical activity.

See also **Drug** (Depressants); **Alcoholism** (Effects); **Sedative**; **Tranquillizer**.



A department store in Berlin. Its huge size makes it possible to stock and sell a wide range of goods in spacious and luxurious surroundings.



**Depression** is a deep, extended slump in total business activity. Buying and selling drop during a depression, causing a decline in production, prices, income, and employment. Money becomes scarce. Many businesses fail, and many workers lose their jobs. A depression can hit an industry, a region, a nation, or the world.

A depression might develop if sales drop in a number of stores. Because of the fall in sales, the stores order less merchandise from manufacturers. The manufacturers, in turn, lower production, cut orders from suppliers, and invest less money in new equipment and factories. As sales drop, prices tend to fall, further reducing business income. Employers lay off workers as business income falls. Bankruptcies may follow.

The depression cycle occurs again and again as unemployment rises. Unemployed workers have less money to spend, leading to further drops in sales, production, income, and employment. The slump feeds on itself, becoming progressively worse until business activity picks up.

Not all business slumps grow into depressions. A milder slowdown in business activity is called a *recession*. Some depressions last several years, but most recessions last only a year or less. In most of the world's industrial nations, depressions and recessions alternate with business expansions. This alternation is called the *business cycle*.

Financial panics at the start of depressions sharply reduce the amount of money available for spending. This may have effects throughout the world, not just within a nation itself. The stock exchange collapse in Britain in 1891 affected investors' confidence in Australia. Many creditors called in their loans. Between 1891 and 1892, a large number of land and finance companies failed because they had extended too much credit. Some small banks also failed. A run on the banks developed as people tried to withdraw their money. Panic spread when the Commercial Bank of Australia in Melbourne closed its doors in April 1893. Further bank crashes followed and there was a severe depression in the 1890's in Australia. The situation was made worse by large-scale strikes in the early 1890's and widespread drought in the late 1890's. Depressions have also occurred after wars, when wartime spending suddenly stops. The worst depression in history was the Great Depression, which struck the world in 1929 and continued through the 1930's. See **Great Depression**.

### Effects

**Effects on individuals.** Depressions hurt great numbers of people, especially workers who lose their jobs. Bank failures wipe out the savings of depositors if such funds are not insured. Many people cannot meet rent or mortgage payments and lose their homes.

During a depression, some people must live on unemployment benefit or charity to survive. They may feel angry and humiliated because they cannot support themselves.

Depressions cause marriage and birth rates to decline. Young people who cannot find jobs delay marriage. Couples uncertain about the future may have fewer children than they would like.

Long periods of unemployment cause people to lose faith in themselves and in the future. After a depression,



**Lines of jobless Americans** were a common sight in large cities during the Great Depression of the 1930's. Men in this queue in Brooklyn, New York City, were waiting for free food.

many people value security more than anything else.

Some people profit from a depression. For example, those who have enough money can buy businesses and other property at low prices. Salaried workers may live better as prices drop and their income buys more.

**Effects on society.** Society suffers as a depression spreads mass unemployment, poverty, and despair. Depressions also change certain beliefs. These changes can affect society. The Great Depression caused many people to distrust business and led the government to regulate business and economic affairs. This increased regulation led to the widespread belief that the government should maintain high employment and guarantee citizens a good life. After the Great Depression, many people no longer trusted employers to protect workers. As a result, trade unions gained more members and greater public acceptance than ever before.

A depression makes some people lose faith in their system of government. They may come to believe any leader who promises a change. Leaders who took power during a depression include Adolf Hitler, who ruled Germany as dictator from 1933 to 1945, and Benito Mussolini, dictator of Italy from 1922 to 1943.

Relations between nations suffer during a depression. Each country tries to protect its own interests without concern for other nations.

### Causes and prevention

Economists disagree on what causes depressions and how they can be prevented. Some economists believe that psychological factors, such as people's optimism or pessimism, determine decisions to save or spend.

Several theories maintain that population changes or



inventions cause periods of expansion and *contraction* (depression or recession). When immigration or higher birth rates cause a population to grow, demand tends to increase. When population growth slows down, demand drops. Such inventions as the car and colour television spur business investment and consumer spending, causing expansion. After demand for these products has been satisfied, spending drops off, resulting in contraction.

Still other theories suggest that during an expansion, businesses invest too heavily in buying equipment and constructing plants and offices. Then, for some time, they have no need to buy or build, and a contraction results.

Most experts believe that another severe depression can be prevented in various ways. Social security and unemployment benefit guarantee that people will have some money to spend. In addition, economists can predict swings in the economy, enabling the government to take preventive action.

A government's chief methods of preventing a depression are by its *fiscal policy* and its *monetary policy*. Fiscal policy refers to a government's taxing and spending programmes. Monetary policy refers to how a government manages the nation's *money supply*—that is, the total quantity of money in the country, including cash and bank deposits. Most economists stress either fiscal policy or monetary policy as the best means of preventing a depression.

**Fiscal policy.** John Maynard Keynes, a British economist who published his theories during the 1930's, explained a depression as the result of a drop in *effective demand*—that is, total spending by consumers, business, and government. He believed that increased savings slow the rate of economic growth. According to Keynes, people's decisions to save or spend depend on what they expect the economy to do. If they expect bad times ahead, they may decide to save their money. Similarly, if businesses do not foresee future sales, they will not invest money in new products or equipment.

According to Keynes, a government can prevent depressions by encouraging spending. Tax cuts, for example, give people more money to spend. A government can increase its own spending in such activities as public works and aid to the poor. In addition, Keynes believed that lower interest rates encourage people and businesses to borrow money, which they will either spend or invest.

**Monetary policy.** Milton Friedman, an American economist, became the main spokesman of a group of economists called *monetarists*. He received the Nobel Prize in 1976 for his research in economics.

Monetarists stress the role of monetary policy and a nation's central bank in preventing depressions. They point out that the Federal Reserve System in the United States deepened the Great Depression by allowing the money supply to shrink in the 1930's. The Federal Reserve System is a United States government agency that controls the nation's money supply.

According to monetarists, severe swings in a nation's economy could be prevented if its central bank increased the money supply at a steady rate. They recommend a rate of 3 to 5 per cent, the approximate rate at which production increases. Monetarists oppose

Keynesian proposals to use government spending and taxation to control the economy.

**Related articles in *World Book* include:**

Business cycle	Unemployment
Great Depression	United States, History of the
Keynes, John Maynard	(The Great Depression)
Recession	

**Depression** is a serious mental disorder in which a person suffers long periods of sadness and other negative feelings. The term *depression* also describes a normal mood involving the sadness, grief, disappointment, or loneliness that everyone experiences at times. This article discusses depression as a mental disorder.

Depressed people may feel fearful, guilty, or helpless. They often cry, and many lose interest in work and social life. Many cases of depression also involve aches, fatigue, loss of appetite, or other physical symptoms. Some depressed patients try to harm or kill themselves. Periods of depression may occur alone, or alternate with periods of *mania* (extreme joy and overactivity) in a disorder called *manic depressive psychosis*.

Psychiatrists do not fully understand the causes of depression, but they have several theories. Some psychiatrists believe that depression follows the loss of a relative, a friend, a job, or a valued goal. Many psychiatrists believe that experiences that occur during early childhood may make some people especially subject to depression later in life.

According to another theory, disturbances in the chemistry of the brain occur during depression. Brain cells communicate with one another by releasing chemicals called *neurotransmitters*. Some experts think that certain neurotransmitters become underactive during depression and overactive during mania. These changes in brain chemistry may be related to disturbances in the body's internal rhythms.

Treatments for depression include hospitalization, psychotherapy, chemotherapy (drugs), and *electroconvulsive therapy* (ECT). Hospitalization is an essential treatment for depressed patients who are suicidal. In psychotherapy, the psychiatrist tries to understand (1) the childhood events that make a person subject to depression and (2) the events that preceded the patient's current depression. Drugs called *tricyclic antidepressants* help more than two-thirds of all severely depressed patients. *Lithium carbonate* is a drug used in treating manic-depressive people. Electroconvulsive therapy is generally used only for patients who fail to respond to other treatment.

See also **Mental illness** (Affective disorders).

**De Quincey, Thomas** (1785-1859), was an English essayist. He wrote a rare kind of imaginative prose that was highly ornate, full of subtle rhythms, and sensitive to the sound and arrangement of words.

At the age of 19, De Quincey started to take opium to ease the pain of severe neuralgic headaches. He was addicted to the drug until he died. He told the story of his addiction in his most famous work, *Confessions of an English Opium Eater* (1821). De Quincey is also known for his imaginative essays describing his visions under the influence of opium. The visions were gorgeous and lofty, as well as tortured and terrible. They have a sense of fearful reality, as in "Vision of Sudden Death" (part of the essay "The English Mail-Coach," 1849).



De Quincey wrote a variety of critical essays, including "On the Knocking at the Gate in *Macbeth*" (1823), "On Murder Considered as One of the Fine Arts" (1827), and "The Literature of Knowledge and the Literature of Power" (1848). His works include important essays on writers of his time, such as William Wordsworth, Samuel Taylor Coleridge, and Charles Lamb.

De Quincey was born in Manchester. He lived in Edinburgh from 1828 until his death.

**Derain, André** (1880-1954), was a French artist. He and his friends Henri Matisse and Maurice de Vlaminck were leaders of the *fauves*, a group of painters of the early 1900's.

Derain's *fauve* paintings, his most significant works, feature vivid colours, particularly blues, oranges, and reds. He applied paint with short, broken brushstrokes. Derain's paintings are flat in design, with little use of perspective. Many of them show the influence of the artists Paul Gauguin and Vincent van Gogh. Derain's *London Bridge* is reproduced in the *Fauves* article. His works after about 1913 are more traditional than his *fauve* paintings. Derain was also noted for his book illustrations and his costume and set designs for ballets and plays. He was born in Chatou.

**Derby** (pop. 7,727) is the administrative centre for the Kimberley region of Western Australia. The shire of Derby-West Kimberley covers an area of 164,329 square kilometres. Derby is located on King Sound, 2,400 kilometres by road northeast of Perth. Cattle, oil exploration, and mining are the main industries in the region. Derby has an average maximum temperature of 35.2° C and an annual rainfall of 547 millimetres.

The Prison Baobab Tree, a hollow tree 16 metres round, stands near Derby. Its name comes from the belief that prisoners were once held inside the tree overnight before being transported to Derby.

The Warwa Aborigines occupied the Derby area be-



**A baobab tree** near Derby in Western Australia is said to have been used as an overnight prison.

fore European settlement. Derby was declared a town in 1883.

**Derby** (pop. 214,000) is a city and local government district in Derbyshire, England. It is the administrative centre of Derbyshire. Derby's modern importance grew with the coming of the railways in the 1800's. For an ac-

count of Derby's other industries, see **Derbyshire** (Economy). Derby has a cathedral and a sports centre.

See also **Derbyshire**.

**Derby** is a famous horse race begun in 1780 by the Earl of Derby in Epsom, England. The race, called "the Epsom Derby" in England, is known as "the English Derby" in other countries.

See also **Horse racing**.

**Derby, Earl of** (1799-1869), Edward Geoffrey Smith Stanley, was British prime minister three times. He formed three short-lived administrations: in 1852, 1858, and 1866.

Stanley was born at Knowsley, in Merseyside, England, and educated at Eton College and Oxford University. He became member of Parliament for Stockbridge in 1820 and, in 1830, was made chief secretary for Ireland in Lord Grey's Whig administration. He ardently supported the Reform Bill. He joined the Tory party in 1834. He succeeded his father as earl in 1851. In 1863, he declined an offer to become the king of Greece.

**Derbyshire**, which lies in the centre of England, is a county of hills, valleys, moorland, and swift-flowing streams. The county takes in much of the Peak District, and is a favourite holiday ground for tourists and local visitors. Derbyshire's varied countryside also includes rich coalfields, industrial towns, and lush farmlands.

England's highest town, the ancient spa of Buxton, is located in northwest Derbyshire, at a height of about 310 metres above sea level.

### People and government

Most of Derbyshire's people live in the eastern, industrialized part of the county.

**Customs.** Derbyshire's people maintain many ancient customs. *Well dressing* is carried out in several villages during the summer. The wells are *dressed* (decorated) with pictures of religious subjects and the clergy and villagers give thanks. The Great Plague of 1665 is remembered each year in Eyam. A religious service is held there on the last Sunday in August. It commemorates



**The county of Derbyshire**, in central England, is a region of hills, valleys, moorlands, rapid streams, and rich farmlands.





**Aeroplane engines** are produced in Derbyshire for many of the world's large new aircraft. Many skilled workers from the city of Derby work in the Rolls-Royce aero engine factory.

villagers who isolated themselves to prevent the plague spreading outside the village. See **Great Plague**.

**Recreation.** Derbyshire has a first-class county cricket team, and Derby and Chesterfield have soccer teams that play in the Football League.

Fishing facilities are good in most parts of the county.

### Places to visit

Following are brief descriptions of some of Derbyshire's interesting places to visit:

**Arborelow** has a prehistoric circle of immense limestone *monoliths* (columns made of single stones). The circle is surrounded by an earth wall.

**Chatsworth** is a vast and beautiful house built in the late 1600's for the first Duke of Devonshire. It attracts thousands of visitors each year to its beautiful grounds and richly decorated interior.

**Chesterfield** is well known for All Saints' Church, with a spire that became crooked because of poor workmanship and the warping of its timber frame.

**Kedleston Hall** is a beautiful country house designed by Robert Adam.

**Peak District National Park** offers exciting opportunities for cavers and rock climbers all the year round. Bird-watchers visit the area to see the varieties of moorland birds.

**Peveril Castle**, at Castleton, is a Norman castle built in the 1000's. The castle was the setting for Sir Walter Scott's historical novel *Peveril of the Peak*.

**Repton** has a church dating from the 700's.

Sailing is popular on the River Trent, and rowing clubs use the River Derwent. Gliding enthusiasts fly at Great Hucklow, near Eyam.

**Local government.** Derbyshire is divided into nine local government districts. They are *Amber Valley*, which includes Belper and Ripley; *Bolsover*; *Chesterfield*; *Derby*; *Derbyshire Dales*; *Erewash*, which includes Ilkeston and Long Eaton; *High Peak*, which covers the northwestern part of the county; *North East Derbyshire*, which includes Clay Cross and Dronfield; and *South Derbyshire*. The administrative centre of the county and west district is Matlock.

The county is policed by the Derbyshire Constabulary, which has headquarters at Ripley. The crown court meets at Derby.

### Economy

**Mining and quarrying.** Coal mining has long been a key industry in Derbyshire. The eastern part of the county shares with Nottinghamshire a large coal and iron ore field. Important mining areas are Alfreton, Bolsover, Clay Cross, Heanor, and Ilkeston.

In the middle regions of the county, vast quarries supply stone for building and road making. The area also has cement and gravel works. There are limestone quarries around Buxton and Wirksworth which produce about a quarter of the nation's limestone. Some lead is mined in the Peak District. The Peak District also produces *blue John*, a rare form of the mineral fluorspar that is used for jewellery and ornaments.

**Manufacturing.** Much raw material for Derbyshire industries comes from coal and iron fields lying along the county's eastern boundary. Heavy engineering and steel industries have developed in the area, especially at Chesterfield. Chesterfield also has chemical industries.

Derby is the centre of Britain's railway locomotive building industry. Locomotives are shipped from Derby to all parts of the world. Many of the people of Derby work in the Rolls-Royce factories, producing aeroplane engines.

Derby is also known for its textile industry, which was established in the 1700's. Textiles produced locally include cotton, silk, and artificial fibres such as nylon and rayon. Crown Derby porcelain is also made in the city.

**Agriculture** in Derbyshire is varied, because of the variety of geological structure in the county. In the north, the soil is poor because of the hills, and most of the farming land is pasture. Only sheep graze on the windy moors. In the valleys, where the land is more fertile, dairy herds graze. Bakewell is an important centre of the dairy industry. There are some level plains in the

### Facts in brief about Derbyshire

**Administrative centre:** Matlock.

**Largest towns:** Derby, Chesterfield, Ilkeston, Long Eaton, Glossop, Heanor.

**Area:** 2,600 square kilometres.

**Population:** 1991 census—915,000.

**Chief products:** *Agriculture*—barley, dairy products. *Manufacturing and processing*—aeroplane engines, chemicals, heavy engineering, iron and steel products, locomotives, porcelain, textiles. *Mining and quarrying*—blue John (fluorspar), coal, iron ore, lead, limestone.



south, where the soil is deeper and crops, particularly barley and oats, can be grown.

**Transportation and communication.** The hilly terrain of northern Derbyshire makes road making difficult. There are only three trunk roads running through the Peak District, although there are adequate roads for general use. The M1 motorway, which links London with northern England and Scotland, runs through the east of the county.

The railway lines linking Manchester with London and the south and west of England run across the Peak District. The main line that runs from Sheffield and the south of England passes through Chesterfield.

A local daily newspaper is published at Derby. The larger towns all have weekly newspapers. A BBC local radio station is based at Derby.

### Land

**Location and size.** Derbyshire is bordered by South Yorkshire and West Yorkshire on the north, Nottinghamshire on the east, Leicestershire on the south, and Staffordshire, Cheshire, and Greater Manchester on the west. The greatest distances are 61 kilometres from north to south and 42 kilometres from east to west.

**Land regions.** There is a striking contrast between the rugged and beautiful Peak District in the northwest and the industrial areas in the south and east. Derbyshire is a county of hills. Most of the land in the county is more than 150 metres above sea level. Some of the Peak District rises higher than 610 metres. The Low Peak, the midwestern part of the county, is a region of limestone dales, short, swift-flowing rivers and streams, and upland pastures. Vast natural caves and old lead mines lie beneath the limestone uplands.

A belt of rich coal and mineral fields runs along the county's southern and eastern boundaries. Between this region and the Low Peak, the land rises to a belt of high moors that end abruptly in *edges*—steep ridges that fall away to the east bank of the River Derwent.

**Rivers.** Most of Derbyshire's rivers are short and swift. The Derwent, about 97 kilometres long, is the largest river. It rises in the High Peak, cuts through a limestone gorge at Matlock, and joins the River Trent on the county's southern border. The Dove rises at Axe Edge in the Peak District. Other rivers include the Wye, Goyt, Doe Lea, and Etherow. Derbyshire has four reservoirs—Derwent, Howden, and Ladybower, in the Peak District; and Carsington Water, near Wirksworth.

**Climate.** The climate is generally mild, except in the uplands, which are usually snow-covered in the winter. Rainfall averages 1,120 millimetres a year in the Peak District, and 740 millimetres in the lowlands. In the lowlands, temperatures average about 3° C in January and 16° C in July.

### History

The Romans occupied Derbyshire and built forts at Buxton and Brough. They also mined lead in the area. Derbyshire later became part of the kingdom of Mercia. In the 800's, the Danes invaded the area and seized the main town of Northworthy, which they renamed Deoraby. The land came under Norman rule in the 1000's.

Mary, Queen of Scots, spent part of her 19 years' imprisonment in Chatsworth House, the Old Hall at Buxton,

and Wingfield Manor. Derby figured prominently in the Jacobite rising of 1745.

The railway pioneer George Stephenson stayed at Chesterfield and helped its industrial growth. Samuel Richardson, an important English novelist of the 1700's, and the philosopher Herbert Spencer were born in Derbyshire. Richard Arkwright built cotton mills at Cromford and Belper. Charles Rolls and Sir Henry Royce manufactured motorcars at Derby.

**Related articles in *World Book* include:**

Arkwright, Sir Richard	Peak District
Chesterfield	Richardson, Samuel
Derby	Rolls, Charles S.
Hobbes, Thomas	Royce, Sir Henry
Mary, Queen of Scots	Spencer, Herbert
Mercia	Stephenson (family)

**Derbyshire Dales** (pop. 67,700) is a local government district in Derbyshire, England. It has small market towns and villages set amid beautiful countryside. Ashbourne is an ancient market town famous for gingerbread. Bakewell is famous for the Bakewell pudding, better known as the Bakewell tart. Matlock lies on the River Derwent. Sheep and dairy farming are the chief activities. High-quality limestone is quarried in Wirksworth. Tourism is important. Local attractions include the historic houses of Chatsworth and Haddon Hall.

See also **Derbyshire**.

**Dermaptera.** See **Insect** (table); **Earwig**.

**Dermatitis** is an inflammation of the skin that itches or burns. It causes redness, swelling, blisters, oozing, crusting, or scaling. It may be produced by friction, heat, cold, or the sun's rays. However, chemical agents most frequently cause dermatitis. These may be strong poisons that affect anyone's skin, or chemicals that irritate the skin of a person who is especially sensitive to the chemicals. These chemicals may be found in certain plants, foods, fabrics, dyes, cosmetics, and medications.

See also **Allergy**; **Eczema**.

**Dermatology** is the branch of medicine that deals with the prevention, diagnosis, and treatment of skin diseases. Doctors who specialize in this field are called *dermatologists*.

Skin ailments treated by dermatologists include inflammations, infections, burns, and tumours. Dermatologists also treat many children and teenagers who have acne or certain allergies. Dermatologists are trained to recognize changes in the skin that indicate a disease in other parts of the body. For example, a certain type of facial rash may be a symptom of *systemic lupus erythematosus*, a disease that affects many internal organs as well as the skin (see **Lupus**).

Dermatology includes research on the structure and function of skin. Some dermatologists perform surgery to correct certain conditions.

See also **Skin** and its list of *Related articles*.

**Dermis.** See **Skin**.

**Derrick.** See **Crane**.

**Derringer.** See **Handgun** (Early handguns; picture: Some historic handguns).

**Derry** (pop. 94,721) is a local government district in Northern Ireland. It is centred on the city of Londonderry, a seaport and the second largest city in Northern Ireland. Until 1984, the district was officially called Londonderry. Workers in Derry make shirts and electronic



goods, and it has engineering and food-processing works. In 1983, a government-sponsored enterprise zone was set up in Derry.

A city called Derry grew up on a hill at a bend in the River Foyle. *Derry* comes from the Irish *Doire* (the oak-wood). During the plantation of Ulster, the city was turned over to the corporation of London, and, in 1613, given the name *Londonderry*.

**Dervish** is a member of one of the mystical religious orders of the Islamic religion. Most dervishes lead wandering lives of self-denial. They live by begging. The word *dervish* comes from Persian, and means *beggar* or *religious mendicant*. In the A.D. 1000's and 1100's, Muslim mystics organized the first dervish orders. Each order lived in a centre resembling a monastery and had its own ritual. One order is known commonly as the *whirling dervishes* because they whirl and dance to the music of a reed pipe as part of their worship. Other orders give special prayers or practise unusual forms of devotion, such as wearing rough clothing, fasting, and



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**Dervishes** are members of certain Islamic religious orders. They devote themselves to prayer and other forms of devotion. Members, *above*, dance and whirl as part of their worship.

keeping vigils. Many Muslims consider dervishes holy, and often think them capable of miracles or predicting the future. Others criticize the dervish orders and practices for introducing changes to fundamental Islam. Dervishes are sometimes called *fakirs*.

**Derwent** is a river in Tasmania in Australia that flows 195 kilometres from Lake St. Clair to Storm Bay. Hobart lies at the mouth of the river. The main tributaries of the Derwent River are the Ouse, Clyde, and Styx. The valley through which the Derwent flows is extremely fertile. Farmers there grow hops, apples, pears, and potatoes. The valley is also important for its timber, fishing, and dairy products. Hydroelectric power stations operate at Tarraleah and Tungatinah. The river mouth provides an excellent deepwater harbour for the city of Hobart.

**Derwentwater, Earl of** (1689-1716), James Radcliffe, an English nobleman, supported James Stuart, "The Old Pretender," in the first Jacobite rising, in 1715. He was born in London. After the death of Queen Anne, in 1714, a plot to restore the exiled Stuart family led to a Jacobite

rebellion in Scotland. Derwentwater led a similar movement in England, but his tiny force surrendered to government troops at Preston. Derwentwater was captured and executed. See also **Jacobite risings**.

**DES** is a synthetic sex hormone used as a drug. It has the properties of natural *oestrogens*, a type of hormone produced by the ovaries of women during their child-bearing years. DES is an abbreviation of the hormone's chemical name, *diethylstilbestrol*.

Beginning in the late 1940's, doctors prescribed DES to pregnant women threatened with miscarriages. It was believed that DES helped prevent miscarriages, but later studies failed to support this belief. In addition, further research has linked the use of DES by pregnant women to the development of medical problems such as cancer in some of their daughters. Several studies have indicated that the daughters have an increased risk of experiencing problems during their own pregnancies. In 1971, U.S. authorities withdrew approval for the use of DES during pregnancy.

**Desai, Morarji** (1896-1995), was India's prime minister from 1977 to 1979.

Desai was born in Gujarat, where his father was a village teacher. He was educated locally and in Bombay. After an early career as a government official, he played a significant part in India's independence struggle. He was appointed minister of commerce and industry, and later, minister of finance in the cabinet of Jawaharlal Nehru, India's first prime minister.

In 1966, Desai unsuccessfully challenged Indira Gandhi for the post of prime minister. In 1967, as part of a compromise, he was appointed deputy prime minister. Two years later he resigned from the government after differences with Indira Gandhi. These differences widened, and during the state of emergency from 1975 to 1977, Desai was imprisoned.

After the opposition's victory in the 1977 elections, he became prime minister and leader of the Janata Party. When his government collapsed in 1979, Desai retired.

**Desalination.** See **Water** (Fresh water from the sea).

**Descartes, René** (1596-1650), was a French philosopher, mathematician, and scientist. He is often called the father of modern philosophy. Descartes invented analytic geometry and was the first philosopher to describe the physical universe in terms of matter and motion. He was a pioneer in the attempt to formulate simple, universal laws of motion that govern all physical change.

Descartes wrote three major works. The first was *Discourse on the Method of Rightly Conducting One's Reason, and Seeking Truth in the Sciences* (1637), commonly known as the *Discourse on Method*. The other two books were *Meditations on First Philosophy* (1641), perhaps his most important work, and *Principles of Philosophy* (1644). His philosophy became known as *Cartesianism*.

**His life.** Descartes was born at La Haye, near Châtelleraut, and was educated at a Jesuit college. He served in the armies of two countries and travelled widely. Money from an inheritance and from patrons enabled him to devote most of his life to study. From 1628 to 1649, Descartes led a quiet, scholarly life in the Netherlands and produced most of his philosophical writings. Late in 1649, he accepted an invitation from Queen Christina to visit Sweden. He became seriously ill



there and died in February 1650.

**His philosophy.** Descartes is called a *dualist* because he claimed that the world consists of two sorts of basic substances—matter and spirit. Matter is the physical universe, of which our bodies are a part. Spirit is the human mind, which interacts with the body but can, in principle, exist without it.



René Descartes

Descartes believed that matter could be understood through certain simple concepts he borrowed from geometry, together with his laws of motion. In Descartes's view, the whole world—including its laws and even the truths of mathematics—was created by God, on whose power everything depends. Descartes thought of God as resembling the mind in that both God and the mind think but have no physical being. But he believed God is unlike the mind in that God is infinite and does not depend for His existence on some other creator.

In *Meditations on First Philosophy*, Descartes first considered the strongest reasons that might be used to show that he could never be certain of anything. These so-called "sceptical" arguments included the idea that perhaps he might be dreaming, so that nothing he seemed to perceive would be real. In another argument, Descartes reflected that perhaps God or some evil spirit was constantly tricking his mind, causing him to believe what was false. Descartes then responded to these arguments. He began with the observation that even if he were dreaming, or constantly deceived, he could at least be certain that he had thoughts, and therefore existed as a thinking being. This, he wrote, was a "clear and distinct" perception of the mind. Nothing could make him doubt it. In another work, Descartes created the famous Latin phrase *cogito, ergo sum*, which means *I think, therefore I am*.

Descartes then argued that he could also clearly and distinctly perceive that an infinitely powerful and good God exists. This God would not allow Descartes to be deceived in his clearest perceptions. Through this conception of God, Descartes sought to establish that the physical world exists with the properties the philosopher assumed in his theories of physics.

See also **Age of Reason** (The worship of reason); **French literature**; **Geometry** (History); **Psychology** (Beginnings).

**Description.** See **Literature** (Kinds of discourse).

**Desegregation.** See **Segregation**.

**Deseret** is a word meaning *honeybee* in the *Book of Mormon*. The Mormons adopted the honeybee as the symbol of hard work necessary for the success of their settlement in Salt Lake Valley, U.S.A. In 1849, they organized the State of Deseret. Congress refused to admit it as a state, and created instead the Territory of Utah.

See also **Mormons**.

**Desert** is generally thought of as a hot, barren region that receives little rainfall. Rainfall is scarce in all desert regions, but deserts are not barren wastelands. Deserts

have a wide variety of land formations and soil substances, and most of them have at least one permanent stream. Deserts cannot support the abundant plant and animal life found in humid climates. But many kinds of plants and animals thrive in deserts.

Scientists do not agree on a single definition for deserts. Some classify a desert as any region that receives an average of less than 25 centimetres of rain annually. Other scientists use the type of soil or vegetation to determine whether a region is a desert. Still others consider all these factors. They define a desert as a region that can support little vegetation because of both insufficient rainfall and dry soil.

Most deserts are in warm climates, but some regions near the North and South poles are also considered deserts. These areas are so cold that moisture freezes there and cannot stimulate plant growth. This article discusses deserts in warm climates.

Deserts cover about a seventh of the earth's land area. By far the largest desert in the world is the Sahara, which is in northern Africa. The Sahara spreads over about 9 million square kilometres. Other large deserts include the Australian Desert; the Arabian Desert on the Arabian Peninsula; the Gobi Desert in China and Mongolia; and the Kalahari Desert in southern Africa. Deserts also cover about 1.3 million square kilometres of the interior of North America.

Deserts do not support large numbers of people. People who do live in a desert region must adjust to the hot, dry climate. In North American deserts, for example, many Indians and Mexicans live in adobe or mud houses that provide insulation from the heat. The same is true of the architecture of Arab settlements around the Sahara Desert, and on the Arabian Peninsula.

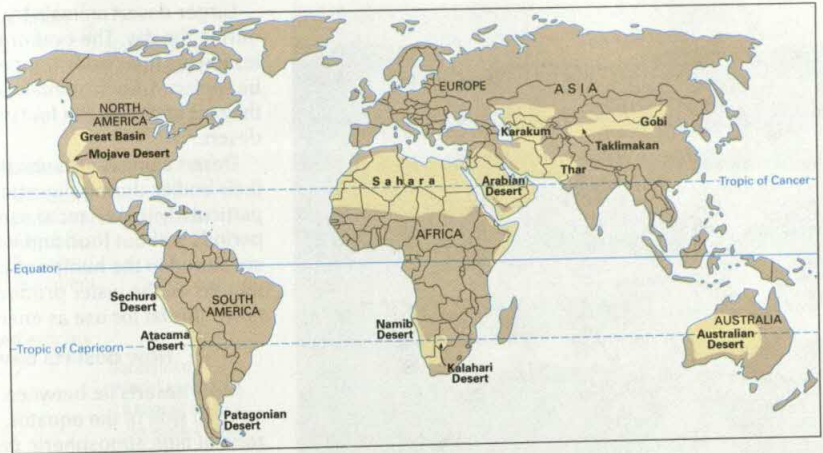
Many desert dwellers in Africa and Asia are herders who move from place to place in search of water and

**Deserts** have highly varied landscapes. This photograph of the Australian Desert shows some of the different types of vegetation and land formations found in desert regions.





**Deserts** cover about a seventh of the earth's land surface. Most deserts lie near the Tropic of Cancer and the Tropic of Capricorn. These regions are high-pressure zones in which cool air descends. The descending air becomes warm and absorbs moisture instead of releasing it as precipitation. Other deserts are in (1) regions separated from the ocean by mountains and (2) coastal areas.



grazing land for their animals. They live in tents and wrap themselves in long cloth robes for protection against the scorching sun and blowing sand. Air-conditioning and irrigation projects have made life more comfortable for other desert dwellers.

### Desert land and climate

Sand covers from 10 to 20 per cent of most deserts. The rest of the land consists mostly of gravel, boulders, mountains, and various types of soil. Most desert soil is too dry to support widespread vegetation, but much of it is rich in salt, uranium, and other minerals. In addition, large deposits of oil and natural gas lie under many desert areas.

A desert landscape includes various land formations created by erosion. The drainage system is made up of dried streams called *arroyos*. After a rainfall, water fills the arroyos. They run down the mountains and cut away at the land, carrying deposits of gravel, rock, and sand to the bottom. The deposits create fan-shaped forms

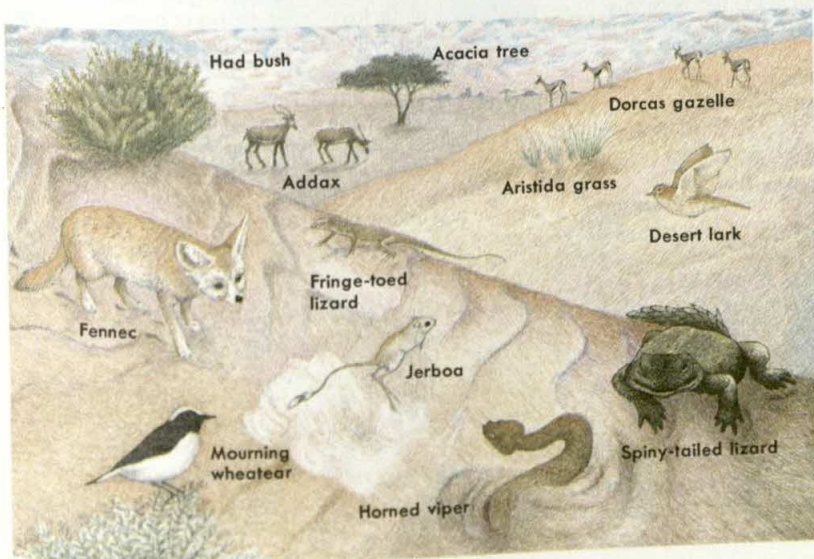
called *alluvial fans*. Erosion also creates flat-topped hills known as *mesas* and smaller mounds called *buttes*.

After rainfall, mountain streams carry water and salt into *playas*, which are dry lake beds that have no outlet. The water that collects either evaporates or seeps into the earth. The salt remains and builds up on the surface.

Parts of the desert are covered by windswept piles of sand called *dunes*, which may reach heights of 250 metres. Dunes have many shapes and patterns that change continually in the high winds.

Oases occur throughout a desert. Many of these fertile areas lie near springs or underground streams. People develop artificial oases through irrigation.

Rainfall in a desert averages less than 25 centimetres yearly. However, the amount of rainfall may vary greatly from year to year. A desert may receive no rain for several years, but then 25 centimetres of rain might fall within a few hours. Desert plants cannot use so much water at once, and the desert soil cannot absorb all of it. Most of the water runs off, carrying away soil particles.



**Many kinds of plants and animals** live in desert regions. The illustration on the left shows some plant and animal life of the Sahara. These organisms have developed various ways to survive the extremely hot, dry climate of the desert.





**Irrigation** provides the water needed to raise crops in a desert. An irrigation project in the Libyan Desert, *above*, enables farmers to grow alfalfa there.

Deserts include the hottest places in the world because they absorb more heat from the sun than does land in humid climates. In summer, desert temperatures often reach 38° C during the day. They drop 25 degrees or more at night. During the winter, temperatures in the desert range from about 10° C to 21° C.

### Life in a desert

**Desert plants** are thinly scattered during dry periods. The plants that survive compete heavily for the small amount of water available, and so they cannot grow close together.

Some desert plants obtain water from deep beneath the surface of the earth. For example, the American mesquite tree has roots that extend as deep as 12 metres. Other plants store large amounts of water in their leaves, roots, or stems. The stem of the barrel cactus bulges with water after a rainfall and shrinks as the plant uses the water.

Certain desert plants survive by reducing their water loss. Most of this loss occurs through the leaves, and so some of the plants shed their leaves during a drought. Others have only tiny leaves, which permit less water to escape.

After a rainfall, colourful flowers and lush vegetation cover parts of a desert. This dramatic change occurs because many desert plants do not grow during a drought. After rain falls, these plants sprout, flower, scatter their seeds, and die. The entire process usually takes only a few weeks.

**Desert animals** include many kinds of insects, spiders, reptiles, birds, and mammals. Deer, foxes, wolves, and other animals may visit a desert after a rainfall.

Most desert animals avoid the extreme midday heat by feeding at night after the temperature has dropped. Many small animals dig burrows underground and stay there during the day. Some of these animals are *dormant* (inactive) throughout the summer.

Larger desert animals try to remain in shady areas during the day. The evaporation of water from their bodies lowers their body temperature, but this water must be replaced. Such animals obtain water from the food they eat and from the few water holes that exist in a desert.

Desert animals also use water that is produced in their bodies during digestion. This source of water is particularly important to camels, which can go for long periods without food and water. Large amounts of fat are stored in the humps of camels. A camel can live for months on the water produced when its body breaks down this fat for use as energy.

### How deserts develop and change

Most deserts lie between the latitudes of 15° and 35° on each side of the equator. These latitudes are in a zone of high atmospheric pressure—that is, an area in which cool air descends and becomes warm. This high-pressure zone is created by the way air moves over the earth. Warm air flows from the equator on each side. It rises, cools, and drops moisture over the subtropical regions near the equator. When this air moves over the areas in latitudes 15° north or south of the equator, it begins to descend and become warm. The warm air absorbs moisture, thus creating the dry conditions of a desert.

Regions separated from an ocean by mountains also tend to be dry. A moist wind blowing inland from an ocean loses its moisture as it rises over mountains and becomes cool. As the wind descends on the side of the mountains facing land, it becomes warm and dry. This warm air creates a *rain shadow*, or dry area. The North American deserts developed partly because of the rain-shadow effect.

The natural forces that create deserts have not changed much for thousands of years. However, various human activities have caused desert regions to expand considerably. This expansion occurs because of the continual loss of fertile land on the outskirts of such regions. Scientists estimate that people destroy millions of acres of this land yearly. Overgrazing of livestock is the chief cause of the loss. Other causes of desert expansion include mining, improper farming methods, and destruction of trees.

Some steps have been taken to prevent further desert expansion and to reclaim some of the barren land. For example, trees have been planted in certain desert areas to reduce the wind at ground level. This procedure prevents sand from being blown on the crops. Scientists believe that improving farming methods and limiting the amount of livestock in desert areas will also help check desert expansion.

**Related articles** in *World Book* include:

#### Deserts

Atacama Desert  
Australian Desert  
Death Valley  
Gobi  
Great Basin  
Great Salt Lake Desert  
Great Victoria Desert  
Kalahari Desert  
Kara Kum

Kyzyl Kum  
Mojave Desert  
Negev  
Painted Desert  
Sahara  
Sahel  
Syrian Desert  
Thar Desert



<b>Desert animal life</b>		
Addax	Chuckwalla	Horned lizard
Animal (pictures: Animals of the deserts)	Courser	Kangaroo rat
Camel	Dromedary	Lizard
	Goanna	Tortoise

<b>Desert plant life</b>	
Cactus	Mesquite
Century plant	Plant (Where plants live)
Date palm	Sagebrush
Flower (pictures: Flowers of the desert)	Saguaro
	Succulent

<b>Other related articles</b>		
Alluvial fan	Irrigation	Sandstorm
Arabs	Mesa	World (graph: Largest desert on each continent)
Bedouins	Mirage	
Butte	Nomad	
Caravan	Oasis	
Climate	Rain	
Dune	Sand	

**De Seversky, Alexander Prokofieff** (1894-1974), was an American pilot, aircraft designer, and military authority. His fighter plane designs were among the most advanced of the 1930's. He invented an automatic bomb-sight, amphibian landing gear, and skis and hydraulic shock absorbers for aircraft. His theories about the use of air power attracted wide attention.

De Seversky was born in Tbilisi, Georgia, then part of Russia. He received his education at Russia's Imperial Naval Academy. He lost a leg in aerial combat in World War I. De Seversky moved to the United States in 1918, after the Bolshevik revolution in Russia. In 1927 he became a naturalized American citizen. De Seversky founded his own aircraft manufacturing firm, the Sever-sky Aero Corporation, in 1922. In 1931, the company was

reorganized as the Seversky Aircraft Corporation. He headed this company until 1939 when it became Republic Aviation. Later, he lectured and wrote *Victory Through Air Power* (1942).

**De Sica, Vittorio** (1902-1974), an Italian film director and actor, became noted for his realistic portrayals of life among the poor. His best films include *Shoeshine* (1946), about war orphans, and *The Bicycle Thieves* (1948), about post-war unemployment. In these and other films, he presented a grim view of life. De Sica's films won critical acclaim, but the hopelessness they implied became unpopular with audiences. After *Umberto D* (1952), De Sica found it difficult to find backing for the type of film he wanted to make.

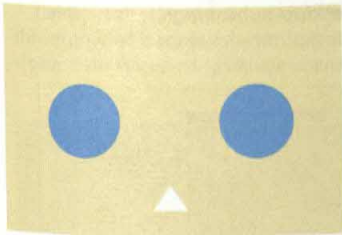
De Sica was born in Sora, Italy. A popular actor, he turned to directing in 1939 and had his first success with *The Children Are Watching* (1942). His other films include *Miracle in Milan* (1951), *Two Women* (1961), *Marriage, Italian Style* (1964), and *The Garden of the Finzi-Continis* (1971).

**Design** is the intended arrangement of materials to produce a certain result or effect. Design plays an important role in all the fine arts and also in the creation of many industrial products. This article discusses the basic design principles which are used in the visual arts.

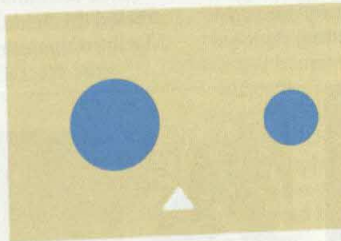
Painters and other visual artists work with *lines*, *shapes*, and *colours*. They are concerned with the *direction* of lines, the *size* of the shapes, and the *shading* of the colours. Visual artists try to arrange these elements into a pattern that will seem emotionally satisfying to the spectator. If this effect is obtained, the design will have *unity*.

**Repetition** consists in the repeating of lines or shapes in large areas of a design. Japanese colour prints are noted for their handling of repetition. Many of these

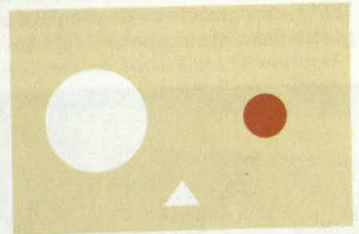
### Some principles of design



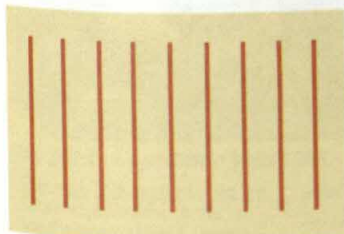
**Symmetrical balance** is achieved if identical shapes are placed an equal distance from the centre of a composition.



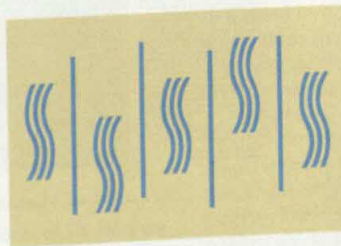
**Asymmetrical balance** results if the larger of two objects is placed closer to the centre than the smaller one.



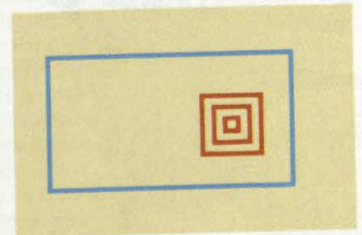
**Visual balance** is created if a small, bright form is placed opposite a larger but less colourful form.



**Repetition** of lines, shapes, and colours can help produce an overall appearance of harmony in a composition.



**Rhythm** provides variety. The repetition of straight and wavy lines gives this design rhythm and a sense of movement.



**Unity** is a satisfying overall effect. Asymmetrical balance, repetition, and harmonious colours help unify this design.



prints have fine slanting lines of rain, or scenes with reflections on water repeated over and over.

**Harmony, or balance**, can be obtained in many ways. It may be either *symmetrical* (in balance) or *asymmetrical* (out of perfect balance, but still pleasing to the eye). Or a small area may balance a large area if the small area has an importance to the eye (because of treatment or colour) that equals that of the larger area.

**Contrast, or discord**, is the opposite of harmony. The colours red and orange harmonize, since orange contains red. A circle and an oval harmonize, because they both are made up of curved lines. However, a short line does not harmonize with a long line. It is in contrast.

**Rhythm and movement** are obtained by the use of wavy lines, or motifs placed in contrast to *static* (set) patterns which give interest to a design.

**Unity** occurs when all the elements in a design combine to form a consistent whole. Unity resembles balance. A design has unity if its masses are balanced, or if its tones and colours harmonize. But unity differs from balance because it implies that the balanced elements work together in harmony in the design as a whole.

**Related articles in World Book** include:

Aeroplane	Engineering	Opera (The designers)
Architecture	Fashion	Painting
Car (Building a car)	Film industry	Sculpture
Clothing (Ready-to-wear clothes)	Furniture	Theatre (Set design)
Drawing	Geometric style	
	Industrial design	
	Interior decoration	

**Design, Interior.** See Interior decoration.

**De Sitter, Willem** (1872-1934), was a noted Dutch astronomer. From his studies of Jupiter's satellites and his calculation of their elements and masses, he contributed to the theoretical understanding of satellites. He is most famous for his work on the age, size, and structure of the universe, and for his early realization of the importance of the Einstein theory of relativity in cosmology. In 1917, he proposed an extension of the theory. He suggested that distant galaxies might be receding rapidly

from us and that, as a result, space might be expanding. His ideas were later proved by observation. De Sitter was born in Sneek in the Netherlands.

**Desktop publishing** is the use of a personal computer to write, illustrate, and lay out high-quality documents. Finished documents—in the form of computer data—are ready for printout on a laser printer. People can also use data produced by desktop publishing to prepare film images of type and graphics for reproduction by printing presses. Publications produced by means of desktop systems range in complexity from simple newsletters that are printed in black and white to magazines and books that are illustrated in full colour.

Desktop publishing, often referred to as DTP, began in the mid-1980's. Since then it has gradually been replacing older methods in which specialists or even separate companies perform various tasks. These tasks include writing and editing, design and illustration, typesetting, and the preparation of type and graphics for printing.

A basic DTP system consists of a personal computer, special software (computer programs), and a *high-resolution* laser printer—one that can print fine details. The software usually includes a word processing program for writing and editing, an illustration program to create graphics, and a page layout program. The layout program is used to set the number and size of published pages, design the layout of the page elements, typeset the text, and place the graphics.

Systems that produce documents with photographs as part of the electronic file also have a device called a *scanner*. This device converts the colours and shades of the photographs into a *digital* (numerical) code. This is the same code that the computer uses to handle all other data, so the computer can manipulate photographs together with type and graphics.

Three technological breakthroughs in the mid-1980's created the field of desktop publishing: (1) the Apple Macintosh personal computer, developed by Apple



**National Hockey League Standings**

Team	W	L	T	Pts
Edmonton Oilers	32	12	2	66
Los Angeles Kings	28	16	2	58
Calgary Flames	27	17	2	56
San Jose Sharks	26	18	2	54
Philadelphia Flyers	25	19	2	52
Washington Capitals	24	20	2	50
St. Louis Blues	23	21	2	48
Chicago Blackhawks	22	22	2	46
Minnesota North Stars	21	23	2	44
Buffalo Sabres	20	24	2	42
Quebec Nordiques	19	25	2	40
Atlanta Thrashers	18	26	2	38
Carolina Hurricanes	17	27	2	36
Florida Panthers	16	28	2	34
Colorado Avalanche	15	29	2	32
San Jose Sharks	14	30	2	30
Los Angeles Kings	13	31	2	28
Edmonton Oilers	12	32	2	26
Calgary Flames	11	33	2	24
Philadelphia Flyers	10	34	2	22
Washington Capitals	9	35	2	20
St. Louis Blues	8	36	2	18
Chicago Blackhawks	7	37	2	16
Minnesota North Stars	6	38	2	14
Buffalo Sabres	5	39	2	12
Quebec Nordiques	4	40	2	10
Atlanta Thrashers	3	41	2	8
Carolina Hurricanes	2	42	2	6
Florida Panthers	1	43	2	4
Colorado Avalanche	0	44	2	2

**Major League Baseball Standings**

Team	W	L	Pct
Los Angeles Dodgers	82	78	.512
San Francisco Giants	79	81	.494
San Diego Padres	76	84	.475
Los Angeles Angels	73	87	.457
San Francisco Giants	70	90	.438
San Diego Padres	67	93	.419
Los Angeles Angels	64	96	.400
San Francisco Giants	61	99	.381
San Diego Padres	58	102	.362
Los Angeles Angels	55	105	.344
San Francisco Giants	52	108	.325
San Diego Padres	49	111	.306
Los Angeles Angels	46	114	.287
San Francisco Giants	43	117	.268
San Diego Padres	40	120	.249
Los Angeles Angels	37	123	.230
San Francisco Giants	34	126	.211
San Diego Padres	31	129	.192
Los Angeles Angels	28	132	.173
San Francisco Giants	25	135	.154
San Diego Padres	22	138	.135
Los Angeles Angels	19	141	.116
San Francisco Giants	16	144	.097
San Diego Padres	13	147	.078
Los Angeles Angels	10	150	.059
San Francisco Giants	7	153	.040
San Diego Padres	4	156	.021
Los Angeles Angels	1	159	.002

**Major League Baseball Standings (continued)**

Team	W	L	Pct
San Francisco Giants	82	78	.512
San Diego Padres	79	81	.494
Los Angeles Angels	76	84	.475
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Computer, Incorporated, (2) Apple's LaserWriter printer, and (3) PostScript, a programming language developed by Adobe Systems, Incorporated. A person using this relatively inexpensive equipment could produce high-quality publications quickly.

Graphic design firms and advertising agencies were among the first to recognize that DTP could save time and money. As DTP systems became more powerful and the cost of equipment decreased, commercial printers and publishers began to use them.

**De Soto, Hernando** (1500?-1542), a Spanish explorer, led the first European expedition to reach the Mississippi River in what is now the United States. His group arrived at the river in 1541 during a search for gold. De Soto also took part in the Spanish conquest of the Inca empire in South America during the 1530's.

De Soto was born in the Estremadura region of Spain, but historians disagree on his exact birthplace. He sailed to Panama while in his teens. De Soto took part in explorations in Central America and helped lead the conquest of Nicaragua, which began in 1524.

From 1531 to 1536, De Soto served as a leader in the conquest of the Inca. This expedition was headed by Francisco Pizarro, another Spanish explorer. In 1534, De Soto was appointed lieutenant governor of Cusco, the Inca capital. He became rich from treasures collected during the Inca conquest.

**Journey to the Mississippi.** In 1537, King Charles I of Spain appointed De Soto governor of Cuba. The king also gave De Soto the right to explore and conquer a region of North America now in the Southern United States. De Soto hoped to find gold there.

De Soto landed near Tampa Bay, off the coast of Florida, in May 1539. His expedition included about 600 soldiers and more than 100 servants. The group headed north and reached Apalache, an Indian area in what is now northeastern Florida.

De Soto continued his unsuccessful search for gold through what became the state of Mississippi. He first sighted the Mississippi River in May 1541. De Soto

crossed the river into what is now Arkansas and explored to the west and south. He then returned to the Mississippi, where he died of fever.

Through the centuries, De Soto became known as a courageous explorer. However, his primary goals were riches and power, for which he and his followers killed and tortured many Indians. De Soto also enslaved Indian men and women, stole their belongings, and held Indian chiefs for ransom.

See also **Exploration** (picture).

**Despotism** is a form of government in which the ruler has unlimited power over the people. Despots are not necessarily harsh or cruel. They may be kindly and considerate, and they may even put the welfare of the people above their own wishes. But usually, despots do not feel bound by the preferences of their subjects, and they sometimes use the greatest force to maintain their power.

The late 1700's are often called the Age of the Enlightened Despots. During this period, Frederick the Great of Prussia, Catherine the Great of Russia, and Joseph II of Austria did their best to reform the laws, to promote education and the arts, and to conduct the affairs of the country efficiently. Charles III of Spain, Leopold of Tuscany, Joseph of Portugal, and Gustavus III of Sweden also deserved the name of "enlightened despots." Some of these rulers learned that freedom and education make rebellious subjects, so they gave up the idea of enlightenment. Nearly all were followed by rulers who undid whatever good the "enlightened despots" had accomplished.

See also **Catherine (II); Frederick II** (of Prussia).

**Dessalines, Jean Jacques** (1758?-1806), is the national hero of Haiti. He was an illiterate slave who freed Haiti from France and became the country's emperor. He was born on a plantation at Grande Rivière, Haiti, and took the name of his French master. He joined the 1791 black revolt that led to the abolition of slavery in 1793. He fought under Toussaint L'Ouverture against the British and became a general (see **Toussaint L'Ouverture**).

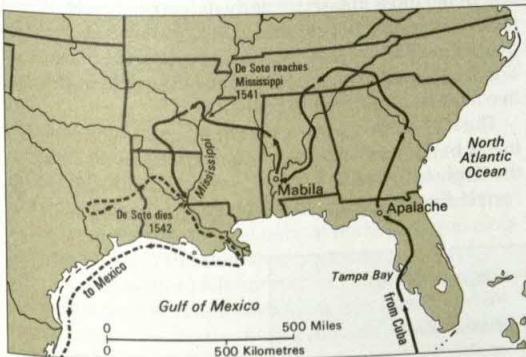
After Toussaint was seized and sent to France, Dessalines led a successful rebellion against the French. This made Haiti the second independent nation in the Western Hemisphere, the United States being the first. Dessalines became president of Haiti on Jan. 1, 1804, but soon proclaimed himself emperor. He was murdered two years later.

See also **Haiti (History); Christophe, Henri.**

**Destouches, Henri-Louis.** See **Celine, Louis-Ferdinand.**

**Destroyer** is a warship. Navies use destroyers chiefly to defend larger warships and amphibious and merchant ships from enemy attack. Destroyers also bombard enemy shores, participate in searches and rescues at sea, and support amphibious landings.

A destroyer measures from about 112 to 172 metres long. Destroyers are usually less than 8,000 metric tons displacement. Most carry a crew of from 300 to 450 people. These ships have light steel hulls with no armour plating. Their armament includes guns that can be fired against air, land, or sea targets. Destroyers can also fire rockets and torpedoes. Destroyers use radar, sonar, and electronic intercept equipment to detect enemy aircraft, surface ships, and submarines.



### De Soto's expedition 1539-1543

This map shows Hernando De Soto's explorations in the Southeastern United States. De Soto found the Mississippi River. He died in 1542, and Luis de Moscoso completed the journey in 1543.

- Route of De Soto
- - - - Route of De Moscoso
- o Indian village





**Destroyers** are used chiefly to defend larger warships. The Japanese navy Hatakaze class destroyer, *above*, carries guided missiles and can hunt and destroy submarines.

Some destroyers are used for antisubmarine warfare. Such ships carry one or two helicopters as their primary antisubmarine weapon. But they also fire rockets and torpedoes against submarines. Many have at least one gun that fires against land, air, or sea targets. Some destroyers carry missiles such as the French *Exocet* which are designed to travel close to the surface of the sea to avoid detection by radar and attack enemy shipping. Ships of the United Kingdom's *Sheffield* class are equipped for area air defence. They have long-range radars to detect aircraft attacking the main fleet. Australia's *Perth* class destroyers are built in the United States, and are intended for anti-aircraft duties. They can carry *Harpoon* missiles, and can attack submarines.

The United States Navy has several classes of destroyers, including the *Charles F. Adams*, *Coontz*, *Kidd*, and *Spruance* classes. The *Spruance* destroyers are used primarily for antisubmarine warfare. The *Charles F. Adams*, *Coontz*, and *Kidd* ships have guided missiles for use against missiles and planes.

Destroyers can reach a maximum speed of about 30 knots (nautical miles per hour). Travelling at 20 knots, the ships can cover 9,700 kilometres without refuelling. Destroyers have turbine engines.

During World War II (1939-1945), the Allied navies used ships called *destroyer escorts*. They were smaller than destroyers and were used mainly for convoy duty. The term *frigate* describes warships slightly smaller than modern destroyers, but otherwise similar in equipment and naval duties.

See also *Frigate*; *Navy*.

**De Sucre, Antonio J.** See Sucre, A. Jose de.

**Detective.** See *Police* (Investigating crime).

**Detective story** is a work of fiction about a puzzling crime, a number of clues, and a detective who eventually solves the mystery. In most detective stories, the crime is murder and the clues lead to or away from the solution.

The pattern of most detective stories is the same, whether the tale is a novel, a novelette, or a short story. The author presents the crime, the detective, and several clues and suspects. The detective follows the clues and may even discover additional crimes. The climax of the story comes when the detective reveals the criminal and tells how the mystery was solved.

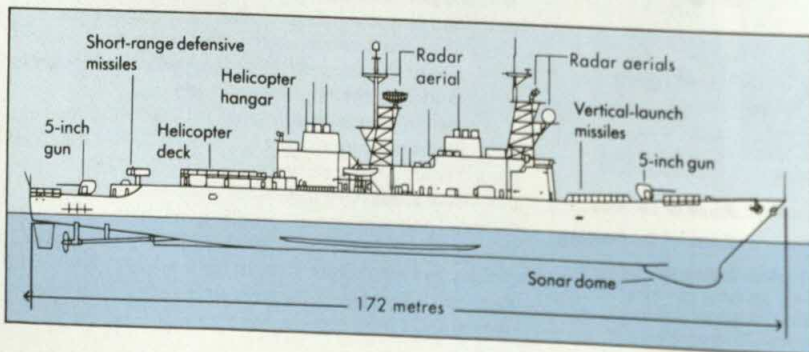
Certain conventions have developed from the detective story pattern. The author is expected to "play fair" with the reader. That is, the reader should be given exactly the same information that the detective uses to find the criminal. Readers can treat the story as a battle of wits between themselves and the detective.

The detective in most of these stories is not a professional police officer but a private consultant. For example, G. K. Chesterton's *Father Brown* is a priest, Rex Stout's *Nero Wolfe* is a gourmet and intellectual, and S. S. Van Dine's *Philo Vance* is a sophisticated socialite. Fictional professional detectives include Wilkie Collins' *Sgt. Cuff*, John Creasey's *Inspector Gideon* (written under the name of J. J. Marric), and Georges Simenon's *Inspector Maigret*. Romance or financial gain may be a factor in a detective story, but the main theme is the mystery and its solution.

**History** of the detective story began with Edgar Allan Poe's "The Murders in the Rue Morgue" (1841). With this story and "The Mystery of Marie Rogêt" and "The Purloined Letter," Poe single-handedly created the literary tradition of detective fiction. His detective was C. Auguste Dupin, a brilliant amateur who uses logic to solve mysteries.

Charles Dickens tried the new form in *Bleak House* (1852-1853) and in his unfinished novel, *The Mystery of Edwin Drood*. Wilkie Collins' *The Moonstone* (1868) was one of the most important early detective novels. Sherlock Holmes and his comrade, Dr. John Watson, appeared in 1887 in Sir Arthur Conan Doyle's *A Study in Scarlet*. Holmes is the most famous character in detective fiction—and perhaps in all fiction.

The early 1900's were a period of excitement and originality in detective fiction. In *The Singing Bone* (1912), the English author R. Austin Freeman introduced the *inverted* detective story, in which the criminal is known



*Spruance* class destroyers of the United States Navy are used largely for antisubmarine warfare. A *Spruance* destroyer is shown in the diagram on the left.



from the beginning. The mystery is whether—and how—the criminal will be uncovered. The American writer Jacques Futrelle created a character called the Thinking Machine, and the Hungarian-born Baroness Orczy introduced the Old Man in the Corner. The period from 1925 to 1935 brought the publication of the first or major works by such detective writers as Margery Allingham, Nicholas Blake, John Dickson Carr, Dame Agatha Christie, Erle Stanley Gardner, Dashiell Hammett, Michael Innes, Msgr. Ronald Knox, Ngaio Marsh, Ellery Queen, Dorothy Sayers, Georges Simenon, Rex Stout, and S. S. Van Dine.

In the 1920's, *Black Mask* magazine introduced a distinctly American style of mystery, often called "private eye" or "hard-boiled" mysteries. These stories focused on a tough detective hero and featured action and violence and a colourful narrative style. Dashiell Hammett was the leader of this style in the 1920's, followed a decade later by Raymond Chandler. The style continues to enjoy great popularity today.

During the mid and late 1900's, a new generation of detective-story writers gained popularity. They included the American writers Emma Lathen, Ross Macdonald, John D. MacDonald, Ed McBain, and Robert B. Parker; the English writers Dick Francis, P. D. James, James McClure, and Ruth Rendell; Janwillem Van de Wetering of the Netherlands; and the Swedish team of Maj Sjöwall and Per Wahlöö.

**Related articles in *World Book* include:**

Chandler, Raymond	Holmes, Sherlock
Chesterton, G. K.	MacDonald, John D.
Christie, Dame Agatha	Orczy, Baroness
Collins, Wilkie	Poe, Edgar Allan
Creasey, John	Queen, Ellery
Doyle, Sir Arthur Conan	Sayers, Dorothy
Francis, Dick	Simenon, Georges
Gardner, Erle Stanley	Stout, Rex
Hammett, Dashiell	

**Detector.** See **Radio** (Amplifiers); **Traffic** (Signals, signs, and markings).

**Detente.** See **International relations** (New patterns of international relations).

**Detergent and soap.** A detergent is a substance that cleans soiled surfaces. Soap is a type of detergent. But the word *detergent* usually refers only to synthetic detergents, which have a different chemical makeup than soap.

Soap and detergent products are produced in the form of bars, flakes, *granules* (grains), liquids, and tablets. People use soap to wash their bodies. They shampoo their hair with soaps and detergents. Daily bathing with soap prevents dirt and natural body oils from clogging the pores of the skin. Doctors clean sores and wounds with soap to kill germs that cause infections.

Detergents and soaps have many household and industrial uses. People use these products to wash their dishes and laundry, to scrub floors, to clean windows, and to do many other household jobs. Industries use detergents and soaps as cleaners, lubricants, softeners, and polishers. For example, tyre manufacturers apply soap to hot tyres to prevent them from sticking to the moulds used in *vulcanizing* (hardening) rubber. Some motor oils contain detergents that break down soot, dust, and other particles that can harm engine parts. Soap is used to polish jewellery and to soften leather.

Detergents and soaps contain a basic cleaning agent called a *surfactant* or *surface active agent*. Surfactants consist of molecules that attach themselves to dirt particles in soiled material. The molecules pull these particles out of the material and hold them in the wash water until they are rinsed away.

The chemical industry manufactures a wide variety of synthetic surfactants, each of which has a different chemical composition. Most detergents contain a synthetic surfactant plus other chemicals. These chemicals may improve a detergent's cleaning ability or make it easier to use. All soaps consist of basically the same kind of surfactant. Detergents and soaps may also contain such ingredients as perfumes and colouring agents.

Detergents have certain advantages over soaps. For example, the most important feature of detergents is their ability to clean effectively in *hard water*. Hard water contains certain minerals, and many soaps cannot be used to launder in it. Such soaps react with the minerals to form a substance called *lime soap* or *soap curd*. Lime soap does not dissolve, and so it is difficult to remove from fabrics and other surfaces. It also causes "bathtub ring." Detergents do not leave such deposits, and they also penetrate soiled areas better than soap does. In addition, detergents dissolve more readily in cold water.

### How detergents and soaps work

Detergents and soaps clean soiled material in much the same way. The cleaning process consists of (1) wetting the soiled material, (2) removing particles of dirt from the material, and (3) *suspending* (holding) the dirt particles in the water until they are rinsed away.

**Wetting the material.** The surfactants in detergents and soaps increase the wetting ability of water by lowering its *surface tension*. Surface tension holds the molecules of water together and causes water to form in drops.

Molecules of surfactant gather at the water's surface and force the water to expand and spread out. With its surface tension reduced, water penetrates the soiled material more completely. Lowering the surface tension also causes surfactants to form bubbles and suds. However, bubbles and suds do not affect the cleaning ability of the product.

**Removing the dirt.** The surfactants in detergents and soaps also help remove dirt. A surfactant has two distinct parts with different characteristics. One part of each surfactant molecule is *hydrophilic* (attracted to water), but the other part is *hydrophobic* (repelled by water). The hydrophobic parts of surfactant molecules attach themselves to any surface other than water. Many hold on to and surround the particles of dirt in the soiled material. At the same time, the hydrophilic parts pull away from the material and pull the dirt toward the wash water.

The mechanical *agitation* (motion) of a washing machine, or the movement caused by rubbing by hand, helps break up the dirt. The agitation also helps the hydrophilic parts of the surfactant molecules pull the dirt particles from the material and into the water.

**Suspending the particles.** After the dirt particles are in the water, the thin layer of surfactant molecules around the particles keeps them separated. These molecules prevent the dirt from settling on the washed



material again. The dirt particles remain suspended in the water until they are rinsed away.

### How soap is made

The chief ingredients of soap are (1) fats and (2) chemicals called *alkalis*. Manufacturers may use animal fats or such vegetable oils as coconut oil and olive oil. Most soapmakers use sodium hydroxide (often called *lye* or *caustic soda*) as the alkali. Potassium hydroxide is the alkali in liquid soaps and in some bar soaps. Manufacturers use two chief methods to make soap, the *kettle method* and *continuous processing*.

**The kettle method.** Until the early 1940's, soap companies made most soap in large kettles. Some soap is still made by this method. Manufacturers use steel tanks that stand three storeys tall and hold more than 45,000 kilograms of ingredients. Steam from coils in the tanks heats the mixture of fats and alkali for several hours.

The heat triggers a chemical reaction called *hydrolysis* or *saponification*. This reaction causes a creamy soap to form within the mixture. Salt is added to the soap, causing the mixture to separate into two layers. The soap, called *neat soap* at this stage, rises to the top of the mixture. A solution of excess alkali, salt, and a liquid called *glycerol* remains beneath the layer of soap (see *Glycerol*).

Other ingredients are added in a huge mixer called a *crutcher*. They include perfumes, colours, *germicides* (germ killers), and *builders* (substances that help remove dirt). The soap mixture is then hardened into bars or made into flakes or granules.

**Continuous processing** makes as much soap in a few hours as can be made in several days by the kettle

method. In continuous processing, soap manufacturers use a stainless-steel tube called a *hydrolyser*. The tube measures about 90 centimetres in diameter and about 25 metres in height. Water under high pressure and heated to a temperature of 260° C is pumped into the top of the hydrolyser. At the same time, a machine pumps in hot fat at the bottom. The fat splits into fatty acids and glycerol. The fatty acids rise to the top. They are removed from the hydrolyser, purified, and mixed with alkali to make soap. The soap is then mixed with other ingredients in a crutcher and made into bars, flakes, or granules.

**Bar soaps** are made for bathing and for laundry use. Manufacturers use several methods to make bars of soap. They make *floating soaps* by mixing the warm soap solution with air in a machine equipped with cooling coils. The machine cools the soap and squeezes it out in the form of a long continuous bar.

In another method, several sets of rollers called *mills* mix and squeeze soap flakes to make *milled soap*. The milling operation produces a hard soap that lathers better than floating soaps.

Modern continuous *finishing machinery* makes soap bars of better quality than those produced by other methods. A machine sprays hot liquid neat soap into a vacuum chamber, where excess moisture and impurities are removed from the soap. Then the dried soap is cut into the shape of noodles and fed into one or two *kneading units*. Perfume is added to the soap, which comes out of the kneading units in a long bar called a *log*.

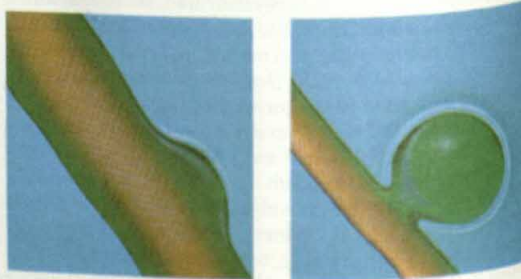
Soap made by any of the above methods is cut into small bars of the desired size, called *blanks*. A *press* or *stamper* forms the bars into various shapes and presses the brand name into the finished soap.

Bar soaps used for bathing are usually called *toilet soaps*. These soaps consist entirely of soap or of a mixture of soap and synthetic surfactants. The synthetic surfactants break up lime soap and prevent the formation of bathtub ring and other deposits. *Deodorant toilet soaps* contain a small amount of a germicide.

**Granules and flakes.** Almost all soap used for home laundering is produced in the form of granules or flakes. Manufacturers make soap granules by pumping warm soap from a crutcher to the top of a tall *drying tower*. The soap is sprayed into a stream of hot air that dries it into bubblelike granules. The granules fall to the



**Soap making** by villagers was performed outside the home in iron kettles. This woman recreates the process as it might have occurred in North America in the 1800's.



**Detergents and soaps clean** in much the same way. In the enlarged illustrations, a detergent attacks an oil drop on a strand of cloth, *left*. It pulls the oil out and forms a thin layer around it, *right*. The detergent and oil are then rinsed away.



bottom of the tower. A filter removes extremely fine particles, and coarse particles are screened out, leaving only granules of about the same size.

Soap flakes are made by pouring soap from a crutcher between two steel rollers, one hot and the other cold. A thin sheet of soap sticks to the cold roller. As the roller turns, the soap is cut into ribbons. A blade scrapes the soap ribbons off the roller. Then the ribbons enter a dryer, where they either break or are cut into flakes.

### How detergents are made

The manufacture of detergents involves several complicated chemical processes. First, the synthetic surfactant is made in a chemical plant. A variety of substances may be used, including by-products of petroleum, as well as the same vegetable oils and animal fats which are used to make soap. For example, many manufacturers use beef fat, which is called *tallow*, in the first step of the process. The tallow is made to react chemically with methyl alcohol. The resulting product is treated with hydrogen gas and reacts to produce *hydrogenated tallow alcohol*. This liquid is treated first with sulphuric acid and then with an alkali. The resulting product is a synthetic surfactant.

Other ingredients are mixed with the synthetic surfactant in a crutcher. They include bleaches, builders, fabric brighteners, suds stabilizers, and substances called *antiredeposition agents*, which help prevent removed dirt from returning to cleaned material. The detergent mixture is then processed into granules, flakes, tablets, or a liquid.

Detergent granules and flakes are produced in much the same way as soap granules and flakes. Manufacturers make detergent tablets by adding special ingredients to detergent granules and then pressing the mixture into tablet form. Liquid detergents are made by

adding various chemical ingredients to the surfactant. This serves to ensure that it remains a liquid at normal temperatures.

### History

**Early soap.** No one knows when or where people first made soap. In about 600 BC, the Phoenicians were making soap from goat's fat and wood ash. Phoenician traders sometimes gave soap to the Celts in exchange for other products. The Celts also made soap themselves from animal fat and wood ash. For further information on these peoples see **Phoenicians and Celts**.

Soap in early times was prized as a medicinal item. It was only much later that its properties as a cleansing agent began to be fully recognized.

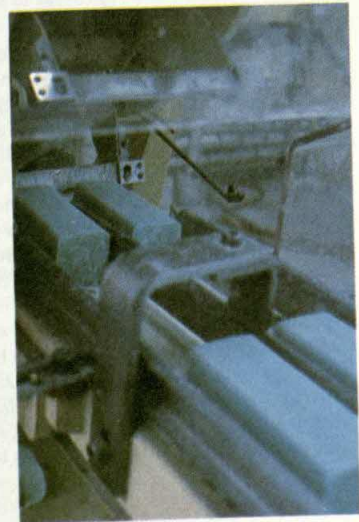
People living in Gaul (France) about A.D. 100 used a rough soap. By about 700, soap making had become a craft in Italy. The Spaniards were Europe's leading soap makers in the 800's, and soap making began in Britain in the 1200's.

In the late 1700's, Nicolas Leblanc, a French scientist, found that lye could be made from ordinary table salt. Following Leblanc's discovery, soap began to be made widely and sold at prices that almost everyone could afford.

The soap industry in North America began in the early 1800's. Some people collected waste fats from others and made soap in large iron kettles. They poured the soap into large wooden frames for hardening. Then they cut the hardened soap into bars that were sold from door to door.

Since the early 1900's, manufacturers have made big improvements in the mildness, colour, fragrance, and cleaning ability of soaps.

**The development of detergents.** Fritz Gunther, a German scientist, is usually credited with developing in 1916 the first synthetic surfactant for use in detergents.



The manufacture of bars of soap begins by making liquid neat soap, *far left*, from fats and chemicals. The neat soap is dried and then cut into soap noodles, *centre*. The noodles are formed into long logs, which are then cut into blanks, *far right*, and pressed into bars of soap.



Industries used his product, but it was too harsh for household use. In 1933, the first household detergents based on synthetic surfactants were introduced in the United States. The shortage of fats and other chemical raw materials during World War II (1939-1945) slowed the further development of such products. After the war, several soap companies began to produce detergents based on synthetic surfactants.

Before 1965, detergents in sewage sometimes caused surface foam on rivers and streams. Most detergents contained a synthetic surfactant called *alkylbenzene sulphonate* (ABS), which did not break down completely in sewage treatment systems. In 1965, after more than 10 years of research, the detergent industry developed a surfactant called *linear alkylbenzene sulphonate* (LAS). Bacteria quickly break down LAS molecules, and so detergents that contain LAS do not cause foam.

In the early 1970's, scientists observed that chemicals called *phosphates*, which were used as detergent builders, contributed to water pollution. When phosphates and other chemicals enter rivers and lakes, they overfertilize simple water organisms called *algae*. Overfertilization increases the growth of algae which causes the oxygen supply in the water to be used up. Fish cannot live in such water, and so they die. Their bodies pollute the rivers and lakes, which also become choked by the algae. See **Eutrophication; Water pollution**.

To help solve the problem, governments in some countries have banned the sale of detergents that contain phosphates. Manufacturers have reduced the amount of phosphates in many detergents. They also have developed several phosphate substitutes, which enable them to produce phosphate-free detergents. **Determinant**, in mathematics, is a single number related to a square *array* (arrangement) of numbers called *elements*. For example, the array

$$\begin{vmatrix} 3 & 1 \\ 2 & 6 \end{vmatrix}$$

is related to the single number 16. You can compute the value of this determinant in three steps. (1) Multiply the upper left element 3 by the lower right element 6:  $3 \times 6 = 18$ . (2) Multiply the lower left element 2 by the upper right element 1:  $2 \times 1 = 2$ . (3) Subtract the product of step 2 from the product of step 1:  $18 - 2 = 16$ . The word *determinant* is also used for the square array itself.

Mathematicians use determinants to state formulas for the solution of many problems. Such problems include the solution of equations and the calculation of certain areas and volumes.

**Using 2 by 2 determinants.** The array above is called a 2 by 2 determinant because it has two *rows* (3,1 and 2,6) and two *columns* (3,2 and 1,6).

In general, the symbols  $a_1$ ,  $b_1$ ,  $a_2$ ,  $b_2$  can be used to represent the numbers of any 2 by 2 determinant. The value of the determinant is stated as follows:

$$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$$

The 2 by 2 determinant can be used to solve linear equations in two variables (see **Algebra** [Solving linear equations in two variables]). For example, suppose you wanted to solve the following equations:

$$\begin{aligned} 3x + 1y &= 5 \\ 2x + 6y &= 14 \end{aligned}$$

To find the value of the variable  $x$ , eliminate the variable  $y$  by multiplying the first equation by 6, and then subtracting the second equation:

$$\begin{aligned} 18x + 6y &= 30 \\ -2x - 6y &= -14 \\ \hline 16x &= 16 \\ x &= \frac{16}{16} = 1 \end{aligned}$$

The above operations could also be written as follows:

$$\begin{aligned} 6 \times 3x + 6 \times 1y &= 6 \times 5 \\ -2x - 6y &= -14 \\ \hline (6 \times 3 - 1 \times 2)x &= 6 \times 5 - 1 \times 14 \\ x &= \frac{6 \times 5 - 1 \times 14}{6 \times 3 - 1 \times 2} \end{aligned}$$

The last expression can be written as the ratio of two determinants:

$$x = \frac{\begin{vmatrix} 5 & 1 \\ 14 & 6 \end{vmatrix}}{\begin{vmatrix} 3 & 1 \\ 2 & 6 \end{vmatrix}} = \frac{5 \times 6 - 14 \times 1}{3 \times 6 - 2 \times 1} = \frac{30 - 14}{18 - 2} = \frac{16}{16} = 1$$

You could solve the original equations in a similar way for  $y$  and get

$$y = \frac{\begin{vmatrix} 3 & 5 \\ 2 & 14 \end{vmatrix}}{\begin{vmatrix} 3 & 1 \\ 2 & 6 \end{vmatrix}} = \frac{3 \times 14 - 2 \times 5}{3 \times 6 - 2 \times 1} = \frac{42 - 10}{18 - 2} = \frac{32}{16} = 2$$

Note that the same determinant appears as the denominator in the formulas for both  $x$  and  $y$ . This determinant is called the *determinant of the system*. It is made up of the coefficients of  $x$  and  $y$  in the original equations (3,1,2,6). The numerator in the formula for  $x$  is the determinant of the system with the coefficients of  $x$  replaced by the constants in the original equations (5,14). Similarly, these constants replace the coefficients of  $y$  in the numerator of the formula for  $y$ .

In general, equations in  $x$  and  $y$  can be written as

$$\begin{aligned} a_1 x + b_1 y &= c_1 \\ a_2 x + b_2 y &= c_2 \end{aligned}$$

You can solve these equations for  $x$  as follows: (1) multiply the first equation by  $b_2$ ; (2) multiply the second equation by  $b_1$ ; (3) subtract the product of step 2 from the product of step 1 to eliminate the terms that contain  $y$ . The result is:



$$(a_1b_2 - a_2b_1)x = c_1b_2 - c_2b_1$$

$$x = \frac{c_1b_2 - c_2b_1}{a_1b_2 - a_2b_1} = \frac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$$

**Using higher order determinants.** The order of a determinant is the number of rows or columns it has. A 2 by 2 determinant is of the *second* order, a 3 by 3 of the *third*, and so on. Determinants of an order higher than the second appear, for example, in the solution of three or more simultaneous equations.

You can use third order determinants to solve the following three equations:

$$\begin{aligned} 3x + 2y + z &= 10 \\ 4y - z &= 5 \\ 5x + y - 2z &= 1 \end{aligned}$$

The formulas for  $x$ ,  $y$ , and  $z$  are similar to the ones used to solve only two equations. The denominator of each formula is the determinant of the system. The numerators are the determinant of the system with the coefficients of  $x$ ,  $y$ , or  $z$  replaced by the constants. For example, the formula for  $x$  is:

$$x = \frac{\begin{vmatrix} 10 & 2 & 1 \\ 5 & 4 & -1 \\ 1 & 1 & -2 \end{vmatrix}}{\begin{vmatrix} 3 & 2 & 1 \\ 0 & 4 & -1 \\ 5 & 1 & -2 \end{vmatrix}}$$

Third order determinants such as the one above can be computed in several ways. One method is to reduce the determinant to a series of 2 by 2 determinants. With this method, the denominator in the above formula can be reduced as follows:

$$\begin{aligned} \begin{vmatrix} 3 & 2 & 1 \\ 0 & 4 & -1 \\ 5 & 1 & -2 \end{vmatrix} &= 3 \begin{vmatrix} 4 & -1 \\ 1 & -2 \end{vmatrix} - 2 \begin{vmatrix} 0 & -1 \\ 5 & -2 \end{vmatrix} + 1 \begin{vmatrix} 0 & 4 \\ 5 & 1 \end{vmatrix} \\ &= 3(-7) - 2(5) + 1(-20) \\ &= -21 - 10 - 20 = -51 \end{aligned}$$

In this operation, each 2 by 2 determinant is multiplied by a number that appears in the first row of the 3 by 3 determinant (3,2,1). The 2 by 2 determinants are called *minors* of these first row elements. For example, the determinant

$$\begin{vmatrix} 4 & -1 \\ 1 & -2 \end{vmatrix}$$

is the minor of 3. It consists of the elements that remain in the 3 by 3 determinant after the row and column in which 3 appears are crossed out. Similarly, the minor of 2 includes the elements that remain after the first row and second column are crossed out.

This series of 2 by 2 determinants is called an *expansion*

*in terms of the minors of the first row.* It consists of the products of the first row elements and their respective minors. The value of the 3 by 3 determinant is computed by alternately adding and subtracting these products. In general terms, the formula for expanding a 3 by 3 determinant in this way is

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$$

Determinants can be expanded similarly in terms of the minors of any row or column if the signs of the minors are properly chosen.

Determinants of orders higher than the third also can be computed by reducing them to 2 by 2 determinants. However, the minors of these determinants are not 2 by 2 determinants. (The order of a minor is always one less than the order of the determinant from which it is formed.) The minors themselves must be repeatedly expanded until 2 by 2 determinants are finally obtained. Mathematicians may use other methods to simplify high order determinants.

**Determinism.** See Free will; Taine, Hippolyte A.

**De Tocqueville, Alexis.** See Tocqueville, Alexis de.

**Detonator** is a small metal or plastic capsule that contains an easily explodable charge. It is used to *detonate* (set off) larger explosive charges, such as dynamite, mines, and bombs. It contains a heat-sensitive *priming charge*, such as lead azide, and a *base charge* of some more powerful explosive, such as RDX. Flame from a fuse or heat from an electric wire ignites the priming charge, which ignites the base charge. The base charge explosion sets off the dynamite, mine, or bomb. Electric detonators require careful handling because they can be set off by a spark of static electricity from the body. Detonators for dynamite are called *blasting caps*. They can cause serious injury and should be handled only by experts.

**Detroit** is the largest city in the Midwestern state of Michigan in the United States of America. It is one of the world's greatest industrial centres. More cars are produced in the Detroit area than anywhere else in the U.S.A. Detroit is often called *Motor City*. It also ranks as a chief U.S. port and a centre of transportation.

Detroit lies on the southeastern border of Michigan, where the Detroit River separates the United States and Canada. For location, see **United States of America**

### Facts in brief

**Population:** City—1,027,974. Metropolitan area—4,382,299.

**Area:** City—363 km<sup>2</sup>. Metropolitan area—11,885 km<sup>2</sup>. Consolidated metropolitan area—13,758 km<sup>2</sup>.

**Climate:** Average temperature—January, -3° C; July, 23° C. Average annual precipitation (rainfall, melted snow, and other forms of moisture)—79 cm.

**Government:** Mayor-council. Terms—4 years for the mayor and the nine council members.

**Founded:** 1701. Incorporated as a city in 1815.



(political map). Central Detroit rises alongside the north bank of the river. Gardens set off the handsome buildings of the Civic Center, which borders the river. The Renaissance Center, another riverfront complex, includes Detroit's tallest building. An area called Greektown is located inland from the waterfront. It has restaurants, shops, and entertainment spots.

Detroit's residential areas spread outward from the central section. Like many other large industrial cities in the United States, Detroit has slums. They stand in sharp contrast to the clean, modern, and relatively wealthy suburbs that surround the city.

Cultural attractions in Detroit include universities and colleges; art, history, children's, science, and military museums; a symphony orchestra; and an opera theatre. The city is also the home of professional U.S. baseball, ice hockey, basketball, and American football teams.

Racial tension between the city's blacks and whites led to a race riot in 1943. During the 1960's, blacks began to push harder for equal rights, and racial tension increased. A riot broke out in a largely black area and lasted for a week in 1967. Afterward, many civic organizations were formed to ease racial tension and to work for improved education, housing, and job opportunities for blacks.

**Economy.** There are thousands of factories in the Detroit metropolitan area. The car factories assemble cars and trucks, and also manufacture many parts for them. Detroit ranks as one of the U.S.A.'s leading producers of business machines, chemicals, hardware, machine tools, and plumbing fixtures. One of the largest salt mines in the United States lies under the city.

Detroit is Michigan's largest port. It serves as a gateway for commerce between eastern and western Great Lakes ports. The Detroit River ranks as one of the busiest inland waterways in the world. The opening of the St. Lawrence Seaway in 1959 made Detroit an international seaport.

**History.** The Wyandot Indians lived in the Detroit re-

**Car manufacturing** is Detroit's chief industry. The city is one of the world's greatest manufacturing centres.



gion before the first white people arrived. In 1701, a group of French settlers led by Antoine de la Mothe Cadillac built a fort on the north bank of the Detroit River. It became an important fur-trading post. The British gained control of the fort in 1760. They surrendered it to the United States in 1796.

Thousands of settlers moved to Detroit from the eastern United States when the Erie Canal opened in 1825. The city became a commercial centre. Detroit served as Michigan's capital from 1837 until 1847.

Shipping on the Great Lakes increased in 1855, when the Soo Canals were completed on the United States-Canadian border. At that time, the city served mainly as a marketing centre for farm products. After the Civil War (1861-1865) ended, manufacturing had become the city's chief activity. During the early 1900's, Henry Ford and other Detroit businessmen helped make the city the centre of the U.S. car industry.

During World War I (1914-1918), Detroit produced military supplies for the Allies. The city's population soared. In 1935, the United Automobile Workers (UAW) trade union was organized in Detroit.

World War II (1939-1945) created thousands of factory jobs manufacturing military supplies. Many people from other parts of the United States, including great numbers of Southern blacks, went to Detroit seeking work.

The city's rapid population growth led to overcrowding in schools, an increase in crime, and tense race relations. Detroit began many urban renewal projects in the 1950's and 1960's. Thousands of white middle-class families moved to suburbs during the 1950's.

Detroit's economy suffered in the mid-1970's because of a nationwide recession and drop in car production. But Detroit's industries recovered by the mid-1980's.

**Deucalion** was the "Noah" of Greek mythology. He was the son of Prometheus, who was a member of the earliest race of gods, called Titans. When Zeus decided to destroy all human beings by a flood because of their wickedness, Prometheus warned Deucalion and Deucalion's wife, Pyrrha. He told them to build a wooden ark. They floated in this ark for nine days, until they landed on the top of Mount Parnassus. When the water went down, they were the only living creatures left on the earth.

Deucalion and Pyrrha asked the oracle at Delphi how they might restore humanity. The oracle told them to "throw the bones of their mother." They guessed this to mean stones, the bones of mother earth. The stones Deucalion threw became men, and those that Pyrrha threw became women. Deucalion and Pyrrha became the ancestors of the Greeks through their son Hellen, for whom the Hellenes (Greeks) were named. The grave of Deucalion was said to be visible in the city of Athens in the ancient temple of Zeus.

**Deuterium**, also called *heavy hydrogen*, is a stable isotope of hydrogen (see **Isotope**). Its chemical symbol is D or  $^2\text{H}$ . Deuterium is an essential part of the hydrogen bomb, and is used in research in atomic physics, biochemistry, and chemistry. About 1 part in 6,700 parts of all normal hydrogen is deuterium.

**Properties.** The mass of an atom of deuterium is about twice that of a normal hydrogen atom. The nucleus of an ordinary hydrogen atom contains only a proton. A hydrogen atom has the atomic mass 1.0079. The



nucleus of a deuterium atom, called a *deuteron*, contains a proton and a neutron. Deuterium has an atomic mass of 2.01410. Deuterium atoms and ordinary hydrogen atoms have one electron. Chemically, deuterium reacts in the same way as ordinary hydrogen. But it generally reacts more slowly and less completely.

Deuterium combines with oxygen to form *deuterium oxide* ( $D_2O$ ), commonly called *heavy water* (see **Heavy water**). Deuterium oxide is used as a *moderator* in heavy water nuclear reactors to reduce the speed of the neutrons released in a nuclear chain reaction. (Slow neutrons are better at producing *fission*—splitting atoms in two—than are fast neutrons.)

**Uses.** Scientists frequently use deuterium to study organic and biochemical reactions. In a process known as *deuterium labelling*, the heavy hydrogen atom serves as an *isotopic tracer* by acting as a substitute for one or more of the regular hydrogen atoms in a molecule. After the reaction is completed, the deuterium can be located by spectroscopic studies. This technique gives scientists important clues as to how the reaction takes place.

Scientists use deuterons as bombarding particles in particle accelerators. One such device, called a *cyclotron*, can accelerate deuterons to energy levels of millions or even billions of electron volts. When these particles hit the target material, they alter the composition of its atoms and form another element or a new isotope of the original element (see **Cyclotron**; **Transmutation of elements**).

Another isotope of hydrogen, called *tritium*, has an atomic mass of about 3. It contains one proton plus two neutrons, and is unstable. When a mixture of deuterium and tritium is triggered by an atomic explosion, a *thermonuclear* (heat-induced) chain reaction takes place. The atoms of the hydrogen isotopes fuse with each other and release large amounts of energy (see **Fusion**; **Nuclear weapon**).

**Discovery.** Harold C. Urey, an American chemist, announced his discovery of deuterium in 1932. Urey applied Niels Bohr's theories of the atom to the hydrogen atom (see **Bohr, Niels**). He distilled liquid hydrogen and detected deuterium in the liquid remaining. Urey won the Nobel Prize in 1934 for his discovery. Gilbert N. Lewis, an American chemist, first separated deuterium oxide from ordinary water in 1932.

See also **Hydrogen**; **Isotope**; **Tritium**; **Urey, Harold C.**

**Deuteron.** See **Deuterium**.

**Deuteronomy** is the name of the fifth book of the Bible, and the last book of the Pentateuch, or Five Books of Moses. The book is written as if it were Moses' farewell speech to the Israelites before they entered the Promised Land, though the book does not claim that Moses was the author. Scholars agree that some parts may date back to the time of Moses but that the book as a whole is probably from the 700's B.C. During the reign of Josiah (639 B.C. to 608 B.C.), a book of law usually identified as an early form of Deuteronomy was found in the Temple in Jerusalem. It became part of a sweeping reform of Israelite life.

Deuteronomy is presented in the style of a sermon. It contains history, laws, a *covenant* (solemn agreement between the people and God), and poetry. It presents these materials in a personal way, calling on the people to obey God.

Deuteronomy can be divided into five main sections. (1) *The introductory speeches* (1: 1-4: 43) review the historical basis of the Israelites' obligation to accept God's rule. (2) *The laws* (4: 44-26: 19) deal with all areas of life. Many of them, including the Ten Commandments (5: 6-21), repeat or expand laws that appear earlier in the Pentateuch. (3) *The covenant section* (27-30) ends with a vivid description of the blessings for the people if they are loyal to God and the curses if they are not. (4) *Moses' farewell* (31-33) includes two well-known poetic songs about his death, the *Song of Moses* (32) and the *Blessing of Moses* (33). (5) *Moses' death* (34) is a moving account of that event.

In addition to obedience to God, Deuteronomy is concerned with justice and equality for all members of society, especially the weaker ones. The book also emphasizes God's great love for the people. The ideas in Deuteronomy had a strong influence on the next six Biblical books, which are sometimes called the *Deuteronomistic History*. Deuteronomy is also one of the works most frequently quoted in the New Testament.

See also **Josiah**; **Moses**; **Pentateuch**; **Ten Commandments**.

**Deutschland.** See **Germany**.

**Deutschland über Alles**, or *Germany Over All*, became Germany's national anthem in 1922. Germany was divided into west and east sections at the end of World War II. In 1952, the third stanza of *Deutschland über Alles* (*Das Deutschlandlied*) became West Germany's anthem. East Germany chose an entirely different song as its anthem. Today, *Deutschlandlied* is Germany's national anthem. Hoffmann von Fallersleben composed *Deutschland über Alles* in 1841.

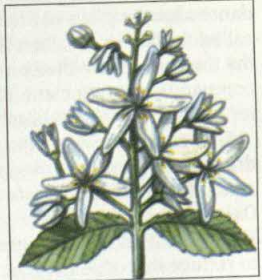
**Deutzia** is a shrub related to the hydrangea. It has clusters of white, pink, or purplish flowers. They bloom in spring or early summer, and usually have five petals. The leaves, which are new each year, have small teeth along the edges and are covered with a rough fuzz. The brown bark peels off on mature plants. *Deutzias* originally grew only in Asia, but they are now cultivated in many parts of the world. They make fine garden borders. See also **Saxifrage**.

**Scientific classification.** *Deutzia* belongs to the saxifrage family, Saxifragaceae, genus *Deutzia*.

**De Vaca.** See **Cabeza de Vaca**, **Álvar Núñez**.

**De Valera, Eamon** (1882-1975), a leader in Ireland's fight to win independence, served three times as prime minister after 1937, and was elected president in 1959 and 1966. He was president of the Irish Free State from 1932 to 1937.

De Valera was born in New York City, of a Spanish father and an Irish mother. He spent his childhood in Ireland and became a leader in the unsuccessful Easter Rebellion in 1916. A British court sentenced him to death, but the sentence was changed to life imprisonment because he was American-born. He was released in 1917,



**Deutzia**



and was elected to the British Parliament. The Sinn Féin convention in 1917 elected him "President of the Irish Republic," a paper organization. He was sent to prison in 1918. De Valera escaped in 1919 and went to the United States.

In 1921, De Valera took part in negotiations with the British government that established the Irish Free State. But this settlement divided Ireland, and he opposed it. In 1926, De Valera quit as president of Sinn Féin because the party refused to recognize the Dáil Éireann (Assembly of Ireland), whose members had to take an oath of allegiance to the British Crown. He then formed the Fianna Fáil (Soldiers of Destiny) party, which won control of the government in 1932. He served as prime minister from 1937 to 1948, from 1951 to 1954, and from 1957 to 1959.

See also Ireland, History of; Sinn Féin.

**De Valois, Dame Ninette** (1898- ), founded Great Britain's Royal Ballet and served as its director until her retirement in 1963. She was born in County Wicklow, Ireland, and trained to be a dancer. In 1926, she opened a school in London and began producing dances for the plays of Shakespeare. The group was first called the Vic-Wells, then the Sadler's Wells Ballet, after the theatres where the company danced. In 1956, the company's name became The Royal Ballet under a charter granted by Queen Elizabeth II.

Dame Ninette *choreographed* (composed) several dramatic ballets, including *Job* (1931), *The Rake's Progress* (1935), and *Checkmate* (1937). She was made a Dame of the British Empire in 1951.

**Devaluation** is a measure that a government may take to reduce the value of its currency in terms of foreign currencies. It is used under certain conditions when a country has a *pegged* or *fixed* exchange rate—that is, when the government specifies the value of its currency in terms of the currencies of other nations. Such conditions for a fixed exchange rate include a deficit in the country's balance of payments and insufficient international reserves to support its exchange rate. A balance of payments is a record of a country's business transactions with other countries and includes exports and imports of goods and services. The objective of devaluation is to improve a country's balance of payments by making exported goods less expensive to foreigners and imported goods more expensive to domestic residents.

Since the early 1970's, many nations have been *floating* their currencies. This means they permit their exchange rate to rise and fall more or less automatically in response to world demand for it. Such changes in turn affect a country's exports and imports in a manner similar to devaluation.

See also Balance of payments.

**Developing country** is any of the world's poor, or "have-not," nations. Such nations were once called *underdeveloped countries*, but most economists now pre-



Eamon de Valera

fer the terms *developing country*, *less developed country*, or *L.D.C.* A typical developing nation has a shortage of food, few sources of power, and a low gross national product (GNP). GNP is the value of all the goods and services produced by a country during a year. Economists often classify nations on the basis of *per capita* (for each person) GNP—that is, the GNP divided by the population.

Most developing countries have an increasing population, chiefly because death rates are decreasing and birth rates remain high. These population increases put new pressures on scarce resources. *Physical capital*, such as machinery and efficient transportation systems, is scarce in developing countries. So is *social capital*, such as good education and health systems and stable government. Disease, illiteracy, and inadequate equipment keep agricultural and commercial production low. These factors are most harmful in rural areas, where most of the people in developing countries live. The people depend on one or two main crops, and suffer if these crops fail.

Richer nations are helping some developing countries conquer poverty, but progress is uneven. Some countries, especially in Africa, are becoming poorer. About three-fourths of the world's people still live in developing countries.

**Related articles in World Book include:**

Colonialism	Industry (In developed and
Economics (Developing economies)	developing nations)
Green Revolution	Peace Corps
	Third World

**Developmental psychology** is the study of changes in behaviour during a lifetime. Many developmental psychologists study only a part of the lifespan. Most are chiefly interested in childhood and adolescence, the period of a person's life between birth and the early 20's.

There are four main theories of child development that psychologists use in research on the behaviour of children: (1) maturational theory, (2) psychoanalytical theory, (3) learning theory, and (4) cognitive theory.

**Maturational theory** states that the chief principle of developmental change is *maturation*, which means physiological "ripening," especially of the nervous system. Arnold L. Gesell, the leading American supporter of this theory, found that the growing child's behaviour seems to follow a set developmental pattern. He described in detail the ways in which behaviour changes with age. Gesell believed that differences among people result more from heredity than from environment. See Gesell, Arnold L.

**Psychoanalytical theory** is based on Sigmund Freud's theory of psychoanalysis. According to Freud, children are driven by impulses of sex and aggression. Children develop through a complicated interaction between their needs, based on sexual impulses, and the demands of their environment. Environmental demands are represented first by loving and restricting parents, and later by the children's own version of their parents' demands. See Libido; Psychoanalysis.

Anna Freud, Erik Erikson, and others have modified Freud's theory and applied it to child behaviour. In the psychoanalytical view of development, children change through conflict, chiefly between their own impulses



and the demands of reality. A successful solution of this conflict brings normal development, and an unsuccessful solution may lead to mental illness.

**Learning theory** says a child's development depends mainly on experience with reward and punishment. The child must learn certain responses—such as speech, manners, and attitudes—to adults. Children learn these responses through their association with *reinforcement* (any condition that makes learning occur). If a mother smiles at her child each time the child is polite to adults, her smile reinforces the learning of manners. The task of the adult is to arrange the environment so that it provides suitable and effective reinforcements for desired behaviour.

Learning theorists base their ideas on two basic learning experiments—studies of classical conditioning by Ivan P. Pavlov and studies of instrumental conditioning by E. L. Thorndike and B. F. Skinner (see **Learning** [How we learn]; Thorndike, Edward L.). Maturation and heredity have relatively little importance in the learning theory of development.

**Cognitive theory** regards the child as an active solver of problems. Cognitive theorists emphasize the role of a child's natural motivation as the key factor in development. This motivation can include the desire of children to satisfy their curiosity, master challenging tasks, or reduce the inconsistencies and ambiguities they find in the world about them. According to cognitive theory, children form their own theories about the world and the relationships among its different aspects. The theories are primitive at first, but become more realistic after they have been tested against the child's experience.

Comprehensive cognitive theories of development have been proposed by a number of authorities, including the Swiss psychologist Jean Piaget. Piaget described in detail how growing children change their ideas about number, cause, time, space, and morality. First, the children represent the world in terms of their own activities. Then they move to a limited set of generalizations based on their knowledge of specific cases. Finally, the children gain the ability to make valid and abstract generalizations about reality.

**Maturity and old age.** In general, the study of psychology in maturity and old age has been based on observation. There have been no clear theoretical principles to guide the search for consistent patterns of development.

Scientists have established that sensory *acuity* (keenness), speed of response, productivity in art and science, and the ability to process new information decline with age, particularly after the late 50's. Less well documented are declines in memory and in the ability to solve familiar kinds of problems. Psychologists know little about the most remarkable fact of old age—that some persons go through a degrading decline with the passage of years, and others remain capable and active until the end of their lives.

**Related articles** in *World Book* include:

Adolescent  
Baby  
Behaviour  
Child  
Freud, Sigmund

Koffka, Kurt  
Motivation  
Personality  
Piaget, Jean  
Psychology

**Devil**, according to many religions, is an evil spirit that opposes God or good spirits. Devils are supposed to tempt people to be wicked. The chief tempter is called the Devil and may command many lesser devils. In Judaism and Christianity, the Devil is also known as *Satan*. In Islam, the religion of the Muslims, the Devil is known as *Iblis*.

Sometimes the religious belief in devils is combined with folklore about ghosts and demons. Most Oriental religions do not accept a single supreme Devil, such as Satan or Iblis. These religions teach that countless devils of equal rank try to harm human beings.

In the Old Testament, the Devil is a *shatan*, a Hebrew word that means *opponent*. The Devil serves as a kind of accuser or prosecutor in God's heavenly court. In the Book of Job, which dates from about the 600's to the 400's B.C., God permits the Devil to test the faith of Job by overwhelming the man with misfortunes. Through the centuries, the Devil became an increasingly evil figure. By the time of the New Testament, he had become the opponent of God and had been expelled from heaven because of his rebellious pride. Since then, the Devil has spitefully tempted humanity to turn against God. In Christianity, the Devil also rules hell, where he and his followers punish the damned.

In many works of art and literature, Satan and other devils are portrayed with animal features, particularly bat's wings, split hooves, and a barbed tail. These features probably symbolize the beastly lust and passion that the Devil represents. Many modern theologians consider the Devil to be a symbol of the power of evil, of the worst qualities of human nature, or of the destructive forces in the universe.

See also **Beelzebub**; **Devil worship**; **Exorcism**; **Lucifer**; **Mephistopheles**; **Witchcraft**.

**Devil worship** is the practice of worshipping demons or other evil spirits. Only a few groups actually worship devils or other beings they consider evil. Members of a Brazilian religious group worship evil spirits called *Exus*, who they believe will harm their enemies. An anti-Christian movement called *Satanism* has a small number of followers in Europe and North America. Satanism involves elements of magic and witchcraft. Its chief ceremony is the *Black Mass*, a distorted version of a Christian church service in which the worshippers praise Satan and ridicule God.

The term *devil worship* is sometimes used by people to describe a religion other than their own. Individuals who consider their religion the only true one may regard the gods of others as devils—especially if the gods are portrayed as fierce. People also may use the term *devil worship* for practices they misinterpret. For example, some groups offer gifts to evil spirits to calm the spirits' anger. Such offerings may seem like devil worship to other people.

A Middle Eastern religious group called the Yazidis acquired the name *devil worshippers* through a misunderstanding. Like early Christians, the Yazidis believe the Devil was once the chief angel but was expelled from heaven because of his rebellious pride. According to the Yazidis, however, the Devil repented and was restored to his former position by God. The Yazidis worship the Devil as the chief angel, who rules the world on behalf of God.



**Devilfish.** See Octopus; Ocean (picture).

**Deville, Henri Étienne Sainte-Claire.** See Aluminium (History).

**Devil's Island.** See French Guiana.

**Devil's paintbrush.** See Hawkweed.

**Devil's Triangle.** See Bermuda Triangle.

**De Vlamingh, William** (1640- ? ), was a skilful and daring Dutch navigator. He was one of the first Europeans to explore the area where the city of Perth, in Western Australia, now stands.

In May 1696, De Vlamingh left the Netherlands in command of the vessels *Geelvinck*, *Nijptangh*, and *Weseltje*. His purpose was to search for survivors of a Dutch East India Company ship that had been lost on its way to Java in 1694. He was also to complete Abel Tasman's survey of the Great South Land and seek treasures in the South Seas.

In December 1696, De Vlamingh visited and named Rottnest Island after what he thought were rats' nests, because he mistook for rats the small wallabies called *quokkas*. In 1697, a party explored and named the *Black Swan River* because of the black swans there.

De Vlamingh surveyed the coast to Exmouth Gulf and landed at various places looking for the survivors. He found a pewter plate that had been left by Dirk Hartog, another Dutch navigator (see **Hartog, Dirk**).

**Devolution** is the transfer of certain powers from the central government to regional governments within a country. In the United Kingdom, devolution became an important issue in the 1970's. Nationalist groups agitated for devolution in both Scotland and Wales, and a government commission under Lord Kilbrandon recommended it to Parliament.

In 1978, the Labour government passed two devolution bills. One bill provided an elected assembly for Scotland. The other provided one for Wales, but with fewer powers. Before setting up the assemblies, the government held a referendum to confirm that the Scots and Welsh really wanted them.

The referendum took place on March 1, 1979. The Scots narrowly voted for an assembly, but only 33 per cent of the electorate went to the polls. In Wales, 58 per cent turned out, and about four-fifths rejected the Welsh assembly. In June, a new Conservative government *repealed* (cancelled) the devolution proposals as they had attracted such little support. Throughout the 1980's and early 1990's, there were renewed calls for devolution.

**Devon**, a county in the southwest of England, has scenery of great beauty and variety. The holiday trade is its largest source of employment and is even more important than farming to the county's economy. Apart from its many seaside resorts, "Glorious Devon," as the county is often called, is also known for its quiet farms, rolling hills, and winding valleys. It includes the Dartmoor National Park, famous for its granite *tors* (hills), and part of Exmoor, which has beautiful scenery associated with R. D. Blackmore's novel *Lorna Doone*.

### People and government

**Local customs.** Many Devon towns have annual fairs and other traditional events. In Exeter, the Lammas Fair takes place in July. The "hot pennies" ceremony opens the town fair held at Honiton, also in July. Other well-known events are Widecombe Fair, Torrington May

### Facts in brief about Devon

**Administrative centre:** Exeter.

**Largest towns:** Plymouth, Torbay, Exeter, Exmouth.

**Area:** 6,710 km<sup>2</sup>.

**Population:** 1991 census—1,008,300.

**Chief products:** *Agriculture*—cattle, fish, flowers, fruit, sheep, vegetables. *Manufacturing and processing*—agricultural implements, carpets, cider, clothing, clotted cream, electronic equipment, lace, leather, paper, pottery, shipbuilding, textiles. *Quarrying*—china clay, clay, roadstone.

Fair, Tavistock Goosey Fair, and the carnival and tar-barrel rolling ceremony held at Ottery St. Mary.

**Local government.** Devon is divided into 10 districts: *East Devon, Exeter, Mid Devon, North Devon, Plymouth, South Hams, Teignbridge, Torbay, Torridge, and West Devon*. Devon County Council, which has headquarters at Exeter, provides some public services throughout the county. The police force is the Devon and Cornwall Constabulary. The crown court meets at Barnstaple, Exeter, and Plymouth.

### Economy

**Tourism** provides more jobs than any other industry in Devon. The chief seaside resorts lie along the warmer southern coast of the county. They include Torbay (which consists of three resorts—Brixham, Paignton, and Torquay), Teignmouth, Dawlish, Exmouth, Sidmouth, and many smaller towns. The northern coast has fine cliff scenery and beautiful surf. Exeter and Plymouth are also important tourist centres.

**Agriculture and fishing.** Farming is Devon's second most important industry. Much of the farming land is used for grazing cattle and sheep. Large numbers of both sheep and cattle are kept in the county. Market gardeners cultivate flowers, vegetables, and fruit in the Tamar Valley and the Combe Martin district. Two traditional Devon products are cider and clotted cream.

Fishing was important in Devon during the early 1900's. But today, it is only a small industry.



**Devon**, a county in southwestern England, lies between Cornwall to the west and Dorset and Somerset to the east.





**Dartmoor ponies** roam freely in the part of southern Devon that is in the Dartmoor National Park. Devon's national parks and seaside resorts attract thousands of visitors each year.

**Manufacturing and mining.** In Plymouth, Devonport, and Stonehouse, many of the workers are employed either in naval dockyards or in shipbuilding. Plymouth also has an electronics factory, which opened in 1987. Both Exeter and Plymouth are major shopping centres.

At Tiverton, many people work at a factory producing textiles. Axminster is known for its carpet industry. Torquay produces and packages flower seeds.

Clay is quarried on the edge of Dartmoor and in the Newton Abbot area.

### Places to visit

Following are brief descriptions of some of the interesting places to visit in Devon:

**Broadhembury** is a beautiful village near Honiton. Hembury Fort nearby dates from the Iron Age.

**Buckland Abbey**, near Plymouth, is a house partly occupied by a museum to Sir Francis Drake.

**Clovelly**, a picturesque fishing village, impassable to traffic.

**Dartmoor**, a national park, is a beautiful area of *tors* (hills) and deep wooded valleys.

**Exeter** has a fine cathedral with towers dating from the 1100's. The Guildhall is probably the oldest municipal building in England. A maritime museum has a collection of small ships.

**Fingle Bridge** at Drewsteignton, near Chagford, is a famous beauty spot.

**Lundy Island** is a seabird sanctuary that can be visited by boat from Ilfracombe.

**Plymouth** has many interesting old buildings. The Barbican includes a Tudor merchant's house. Nearby is Saltram House.

**Transportation and communication.** A main rail line from London runs through Exeter, Newton Abbot, and Plymouth. Branch lines connect Torbay with Newton Abbot, Exeter with Barnstaple, and Exeter with Exmouth. Airports operate at Exeter and Plymouth.

Important roads providing access to the county are the M5 motorway and the A303/A30. Within the county, the A38, A30, and A361 are the principal routes. Plymouth has a ferry service operating to Roscoff, in France, and to Santander, in Spain.

Daily newspapers are published at Exeter, Torquay, and Plymouth. The county has many weekly newspapers. Offices of BBC South West Television and of West Country Television, an independent television company, are at Plymouth. Plymouth also has an independent radio station. Exeter has both an independent local radio station and a BBC local radio station.

### Land

**Location and size.** Devon is bounded by the Bristol Channel and the Atlantic Ocean on the north, by the counties of Somerset and Dorset on the east, by the English Channel on the south, and by Cornwall on the west. The county extends for 121 kilometres from north to south and 118 kilometres from east to west.

**Land regions.** The rolling upland of *Exmoor*, in the north, lies mostly in Somerset. *East Devon* is mostly hilly, with lighter soils on the hills and deep rich soils in the valleys. The *Vale of Exeter* includes the low-lying areas of the Exe, Creedy, and Culm rivers. The soils of the Vale of Exeter are mostly red in colour and are deep and rich. The *South Hams*, which is the southernmost part of the county, consists of a plateaulike area rising to



about 120 metres. The higher ground is broken by deep, fertile valleys, which have a warm climate. The area is called the *Garden of Devon* because of its fertility. North of the South Hams, the granite plateau of *Dartmoor*, with its rolling foothills and thin soils, rises to 621 metres at High Willhays. The Tamar Valley is sheltered by Dartmoor on one side and the Cornish moors on the other. On the lower ground the soil is extremely fertile. *West and Mid Devon* is the largest single region in the county. The soil is less fertile than in most other regions.

**Rivers and lakes.** The two longest rivers, the Tamar and the Exe, flow from north to south into the English Channel. Other important rivers in the county are the Taw and the Torridge. Much of Dartmoor is waterlogged, and rivers flow in nearly all directions from the moor to the sea. The chief of these rivers, apart from the Taw, are the Dart, Plym, and Teign. The largest sheets of water are artificially created reservoirs. The Burrator reservoir provides water for Plymouth.

**Climate.** The climate of Devon is tempered by the sea. The winters tend to be mild, and the summers, cool. The average temperature for February, the coldest month, is 5° C and for August, the hottest month, about 16° C. The average annual rainfall varies from 1,400 millimetres at Princetown, on Dartmoor, to 810 millimetres at Exeter.

### History

Devon has been a generally peaceful county, partly because of its remoteness. Exeter was always an important local capital and was once a walled city. Before the Roman occupation, Exeter (Isca Dumnoniorum, as it was then called) was the tribal capital of the Celtic kingdom of Dumnonia (see Celts).

Devon has lost its former basic industries of cloth production and mining. But it attracts new residents because of its scenery and mild winters.

Devon is associated with many great men, such as the painters Nicholas Hilliard, Sir James Millais, and Sir Joshua Reynolds; the sea captains Sir Francis Drake and Sir Walter Raleigh; and the lawyer Henry de Bracton. A Christian missionary, St. Boniface, was born in Devon.

A number of eminent writers were born in Devon. They include Richard Hooker, John Gay, and Samuel Taylor Coleridge. John Galsworthy, the novelist and dramatist, lived and wrote for many years at Manaton. In recent years, the most important writer associated with the county has been Henry Williamson.

**Related articles in *World Book* include:**

Blackmore, Richard Dodridge	Hilliard, Nicholas
Boniface, Saint	Hooker, Richard
Bracton, Henry de	Kingsley, Charles
Coleridge, Samuel Taylor	Lundy Island
Drake, Sir Francis	Paignton
Exeter	Plymouth
Exmoor	Raleigh, Sir Walter
Ford, John (1586-1639)	Reynolds, Sir Joshua
Galsworthy, John	Torbay
Gay, John	Williamson, Henry

**Devonian Period**, in geology, is a period of the earth's history. It began approximately 410 million years ago and lasted for 50 million years. During this time, seas covered large areas of the continents, laying down thick sediment that became rock. The Devonian Period has been called the Age of Fishes.

See also **Earth** (table: Outline of the earth's history); **Fish** (The Age of Fishes); **Prehistoric animal** (Animals with backbones).

**Devonport** (pop. 24,622) is a major port in northwestern Tasmania, Australia. The city's harbour, at the mouth of the Mersey River, is the terminus for the ferry from Melbourne. Factories in Devonport produce dairy and meat products, textiles, timber, processed food, starch, and flour.

The Tiagarra Aboriginal Cultural and Arts Centre has preserved carvings and other relics of the Tasmanian Aborigines. Nearby is the Mersey Bluff Lighthouse, built in 1881. Another tourist attraction is Home Hill, the residence of Joseph Lyons and his wife, Dame Enid Lyons. Lyons was the only Australian prime minister born in Tasmania. His wife was the first female Cabinet member.

The Devonport area, which was first settled in 1829, was originally divided into two townships, Torquay and Formby. In 1890, the two townships joined together. Devonport was proclaimed a city in 1981.

**Devonshire, Duke of** (1720-1764), William Cavendish, became Prime Minister of Britain in November 1756. He was reluctant to accept the position. He agreed only after King George II promised that he could resign at the end of that session of Parliament. In May 1757, the king unwillingly accepted Devonshire's resignation.

Devonshire's family, the Cavendishes, were among the most powerful political families in Britain. William entered Parliament in 1741 and became the fourth Duke of Devonshire on the death of his father in 1755. In the same year, he became Lord Lieutenant of Ireland, holding that office until November 1756. Devonshire served as Lord Chamberlain from 1757 until 1762.

**De Voto, Bernard Augustine** (1897-1955), an American editor and critic, became well known for his histories of the western frontier. He won the Pulitzer Prize for *Across the Wide Missouri* in 1948. He also wrote a history, *The Year of Decision: 1846*, and *Literary Fallacy*, a criticism of fiction writing. He wrote fiction under the name John August. He wrote his books like a straight-talking frontiersman. De Voto promoted conservation in a column in *Harper's* magazine. He served as editor of *The Saturday Review of Literature* from 1936 to 1938. De Voto was born in Ogden, Utah, on Jan. 11, 1897.

**Devoy, Susan** (1964- ), a New Zealand squash champion, ranked as the world's top woman player in the mid-1980's. She won the British Open Squash Championship for seven consecutive years—1984 to 1990—and again in 1992. She also won the world championships in Dublin in 1985. She was born in Rotorua, New Zealand.

**De Vries, Hugo** (1848-1935), a Dutch botanist and student of organic evolution, was known primarily as the author of the *mutation theory* (see *Mutation*). This theory states that new species of plants and animals arise by *mutations* (sudden transformations) which may appear at any time and are then continued from generation to generation. De Vries' work stimulated research on heredity and evolution. However, mutations as conspicuous as those he described in the evening primrose were later proved to be the exception, not the rule. Born in Haarlem, the Netherlands, de Vries became famous with the publication of *The Mutation Theory* (1901-1903). **Dew** is the name given to the glistening beads of water



that often appear on blades of grass, leaves, and car tops early on clear mornings. Dew forms when air near the ground cools to the point where it cannot hold all its water vapour. The excess water vapour then *condenses* (changes to liquid) on objects near the ground.

During the day, objects absorb heat from the sun. At night, they lose this heat through a process known as *thermal radiation*. As objects near the ground cool, the temperature of the air immediately surrounding them is also reduced. Colder air cannot hold as much water vapour as warmer air can. If the air continues to cool, it will eventually reach the *dew point*. The dew point is the temperature at which the air contains as much water vapour as it possibly can hold (see **Dew point**). If the air cools further, some of the vapour condenses on the nearest available surface.

Dew forms best on calm, clear nights. When the wind is blowing, air cannot stay in contact with cool objects as long and it needs more time to cool to the dew point. When it is cloudy, objects cool more slowly because the clouds radiate heat back to earth. Dew also forms better when the humidity is high.

Dew evaporates as the sun rises. The sunshine heats the ground, which in turn warms the air. This warmer air is able to hold more water vapour, and dew evaporates into this air.

When ordinary dew forms at the dew point and then freezes, it is called *frozen dew* or *white dew*. *Frost* forms when the dew point is below freezing, causing excess water vapour to freeze directly.

**DEW line**, which stands for *Distant Early Warning line*, provides the United States and Canada with warning of an air attack from the north. The DEW line had 31 radar stations and once extended from northwest Alaska to the east coast of Greenland. In 1985, the United States and Canada agreed to gradually replace the DEW line with an upgraded system, renamed the North Warning System. See **Radar** (In the military; map).

**Dew point** is the temperature at which moisture in the air begins to condense. The dew point is either lower than the air temperature, or the same as the air temperature, when the relative humidity is 100 per cent. Dew forms when a thin film of air, in contact with the surface, is cooled to below the dew point. This cooling of the air causes dew on the surface or fog in the air, when the dew point is above the freezing temperature. If the air temperature and dew point are below freezing, frost may form on the surface, or ice crystals may form in the air. Fog and clouds occur when large volumes of air are cooled to below the dew point.

See also **Dew**; **Fog**; **Frost**; **Humidity**.

**Dew pond** is a shallow pool of water. Most dew ponds lie in chalky, upland areas such as the South Downs in southern England (see **Downs**). They retain their water for long periods, even during drought.

Most dew ponds are artificial. Farmers make them by cutting hollows in the chalk, then lining the hollows with cement or clay to prevent drainage. Dew ponds have no apparent water supply. For a long time, people believed that their water came from *dew* (water vapour condensed from the air). This theory is the origin of the name *dew pond*. But experts have found little evidence to support this explanation.

**Dewantara, Ki Hajar**. See **Suardi Sunyaningrat**.

**Dewberry** is a small, oval fruit that grows on a trailing blackberry plant. Unlike other blackberries, which grow on erect bushes, dewberries develop on long, slender branches that spread along the ground. They are black or various shades of red. Each fruit consists of a cluster of tiny fruits called *drupelets*. Dewberries are eaten fresh or used to make pies, jam, or wine.



**Dewberries**

Growers produce dewberry plants by burying sections of stems or roots in mounds of earth. As the plants grow, they are tied to stakes or wire frames to ensure their proper development and to allow growers to care for them easily. The plants produce new stems each year, but only two-year-old stems bear fruit.

**Scientific classification.** Dewberries belong to the rose family, *Rosaceae*. The southern dewberry is *Rubus trivialis*; the western dewberry, *R. ursinus*.

See also **Blackberry**; **Boysenberry**; **Loganberry**.

**De Wet, Christiaan Rudolf** (1854-1922), was a famous guerrilla leader and politician in South Africa. He was born at Leeuwkop in the Orange Free State. De Wet joined his first *commando* (armed raiding unit) at the age of 11 during wars against the Sotho king, Moshoeshe. During the Anglo-Boer War (1899-1902), he led the Heilbron Boer commando with distinction, harassing British lines of communication and supply with sudden raids. There were many "de Wet hunts" as the British tried in vain to capture him. After the fighting, he wrote about his experiences in *Three Years' War* (1902).

During World War I (1914-1918), de Wet joined a rebellion against the government of Louis Botha. He was captured and convicted of high treason. He was briefly imprisoned, but was released in 1915 to placate Afrikaner opinion. He retained his ideal of Afrikaner freedom until his death.

**Dewey, George** (1837-1917), an American naval officer, won fame as the *hero of Manila* during the Spanish-American War (1898).

Dewey was in Hong Kong in command of the Asiatic Squadron when war broke out between Spain and the United States in 1898. He received orders on April 25 to go to the Philippine Islands and capture or destroy the Spanish fleet. Late on April 30, Dewey's six ships, led by the U.S.S. *Olympia*, approached Manila Bay. Early the next day Dewey gave the captain of the *Olympia* the famous command, "You may fire when you are ready, Gridley," and attacked the Spanish fleet of 10 cruisers and gunboats. Dewey's force destroyed the fleet without the



**Admiral George Dewey**



loss of a single American life. This victory made the United States an important power in the Pacific Ocean and inspired the confidence of the American people in the U.S. Navy.

Dewey was born in Montpelier, Vermont, U.S.A. He studied at Norwich Military Academy and at the United States Naval Academy at Annapolis. Dewey saw his first wartime naval service in the Civil War. As a lieutenant, he became the executive officer of the U.S.S. *Mississippi* in David Farragut's fleet in 1861. He took part in the famous run past the forts that guarded New Orleans. Later, Dewey served on Farragut's flagship. Dewey became president of the newly created General Board of the Navy Department in 1900, and the following year he served as president of the Schley court of inquiry.

See also **Spanish-American War**.

**Dewey, John** (1859-1952), was an American philosopher and educator. He was one of the first philosophers to be influenced by psychology and the theory of evolution put forward by the British naturalist Charles Darwin. Dewey was one of the leaders of the movement known as pragmatism (see **Pragmatism**). Among other things, Dewey believed that we use intelligence as an instrument to cope with a conflict or challenge. His philosophy is thus called *instrumentalism*.

In every area of life, Dewey called for experimenting and trying out new methods. As an educator, he opposed the traditional method of learning by memory under the authority of teachers.

John Dewey was born in Burlington, Vermont, U.S.A. He taught at several universities, notably at Columbia University, New York, where he worked from 1904 to 1930. Dewey wrote widely on art, democracy, education, philosophy, and science. His major works include *Democracy and Education* (1916), *Art as Experience* (1934), and *Experience and Nature* (1925).

**Dewey, Melvil** (1851-1931), an American librarian, began the decimal library-classification system (see **Dewey Decimal Classification**). He founded the American Library Association and the *Library Journal* in 1876. He became chief librarian of Columbia University in 1883, and established the first library school there in 1887. He served as the director of the New York State Library between the years 1889 and 1906. Dewey was born in Adams Center, New York.

**Dewey Decimal Classification** is the most widely used method of classifying books in a library. It is named after Melvil Dewey, who developed it in 1876 (see **Dewey, Melvil**). This system classifies books by dividing them into 10 main groups, each represented by figures, as in the table with this article.

Each of these 10 main classes is broken up into more specialized fields. For example, class 600-699, Technology, is subdivided into 10 special classes. Each of these divisions is further subdivided. The numbers 630-639, for example, represent Agriculture, and are subdivided into such classes as Field Crops, Garden Crops, and Dairy and Related Technologies.

When the classification becomes very fine, decimals are used to represent specific areas. For example, books on useful insects, such as bees and silkworms, are grouped under the number 638. Books on beekeeping are under the number 638.1, and those on silkworms in 638.2.

### Main Dewey Decimal Classification groups

<b>000-099</b>	Generalities (encyclopedias, bibliographies, periodicals, journalism)
<b>100-199</b>	Philosophy and related disciplines (philosophy, psychology, logic)
<b>200-299</b>	Religion
<b>300-399</b>	Social sciences (economics, sociology, civics, law, education, vocations, customs)
<b>400-499</b>	Language (language, dictionaries, grammar)
<b>500-599</b>	Pure sciences (mathematics, astronomy, physics, chemistry, geology, palaeontology, biology, zoology, botany)
<b>600-699</b>	Technology and applied sciences (medicine, engineering, agriculture, home economics, business, radio, television, aviation)
<b>700-799</b>	The arts (architecture, sculpture, painting, music, photography, recreation)
<b>800-899</b>	Literature (novels, poetry, plays, criticism)
<b>900-999</b>	Geography, history, and related disciplines

Some libraries do not use the Dewey Decimal Classification. They have their own systems for classifying books.

**Dexedrine**. See **Amphetamine**.

**Dextrin** is a sticky substance formed during the chemical breakdown of starch. Some dextrins are used as a *mucilage* (glue) on postage stamps and envelopes. Dextrins are also used in *sizing* (stiffening) paper and textiles. Such commercial dextrins are produced by treating starch with heat or acid or both. Dextrins are also produced in the human body. During digestion, starch-containing foods are broken down into dextrins and other products. See also **Starch**.

**Dextrose** is the name used in industry for pure, crystalline glucose sugar. It is usually sold in the form of fine, white *granules* (grains). Dextrose is produced commercially by treatment of starch with the enzyme *amylase* or by putting starch in water mixed with dilute hydrochloric acid. When the starch-acid mixture is heated under steam pressure in a converter, it changes to glucose. Glucose can be purified and dried to fine granules called dextrose. As a pure white sugar, dextrose is used mainly in sweets, baked goods, and canned fruit. As a syrup, dextrose is used to produce *high-fructose corn syrup*, a sweetener in many foods and beverages. Dextrose is not as sweet as *sucrose* (common table sugar).

See also **Glucose**.

**Dhaka** (pop. 3,637,892) is the capital, largest city, and commercial and industrial centre of Bangladesh. Dhaka, formerly spelled *Dacca*, lies on the Buriganga River. For location, see **Bangladesh** (map).

The old section of Dhaka, called the Sadarghat, includes the city's main shopping district and a busy outdoor market known as the *Chauk*. The Sadarghat has many *mosques* (Muslim houses of worship), some of which are hundreds of years old. Large numbers of poor families live in crowded slums in the Sadarghat. Middle-class and wealthy people make up most of the population of Ramna, one of the city's fastest growing areas. Ramna lies on the northern edge of Dhaka. It is the home of the University of Dhaka and has many tree-lined streets, a park, and a shopping district.

The central location of Dhaka helped it become the nation's commercial and industrial centre. Factories operate in many parts of the city and its suburbs. The



Dhaka area's major products include cotton fabrics, glass, leather, metals, sugar, and *jute*, a plant fibre used in making rope and certain fabrics.

Settlers from South Asia founded Dhaka in the A.D. 600's. In 1608, the city became the capital of Bengal, a province of the Mughal Empire (see *Mughal Empire*). Dhaka came under British control in the mid-1700's as part of India. India gained independence from Great Britain in 1947, and part of it—including what is now Bangladesh—became the independent nation of Pakistan. Dhaka was named the capital of the Pakistani province of East Pakistan. In 1971, civil war in Pakistan led to the establishment of East Pakistan as an independent nation, Bangladesh, with Dhaka as the capital.

See also *Bangladesh* (pictures).

**Dharma** is the moral and religious law of Buddhism and Hinduism. Each of these religions has its own dharma.

In Buddhism, the dharma is reflected in the teachings of Buddha, who founded the religion. The principles of the Buddhist dharma govern daily life and show the way to salvation. Buddha preached that life is a continuing cycle of death and rebirth. He taught that by following Buddhist ways of life called the *Middle Way* and the *Noble Eightfold Path*, a person could overcome suffering and achieve *nirvana*, a state of peace and happiness. Buddha's followers compiled his teachings in a scripture called the *Tripitika*.

In Hinduism, the dharma establishes rules of duty and ethical conduct for all people. The Hindu dharma also sets forth the responsibilities of the four major *castes* (classes) that make up Hindu society. Writings called the *Dharma Sutras* and the *Dharma Commentaries* explain these principles.

See also *Buddha*; *Buddhism*; *Hinduism*; *Nirvana*.

**Dhoti.** See *India* (Clothing).

**Diabetes** is the name of two diseases that have the same symptoms, excessive thirst and the production of large quantities of urine. *Diabetes* usually refers to *diabetes mellitus*, by far the more common disease, in which the body cannot use sugar normally. In the other disease, *diabetes insipidus*, the pituitary gland or the *hypothalamus*, a part of the brain, functions abnormally.

**Diabetes mellitus** is a common disease, affecting an estimated 30 million people worldwide. About half of them do not know they are diabetic. The body of a diabetic person is slow in using *glucose* (sugar), and so glucose builds up in the blood. The kidneys discharge some of the excess glucose into the urine. In severe cases of diabetes, fats and proteins also cannot be used normally.

Most doctors once believed that all cases of diabetes were caused by a lack of the hormone *insulin*. Insulin, which is produced by the pancreas, enables the body to use and store glucose quickly. Some diabetics do lack insulin. This form of the disease is called *Type I diabetes* (also known as *insulin-dependent diabetes*, IDDM). However, many diabetics—especially those who become diabetic after the age of 40—have normal or in some cases even above-normal production of insulin. Their bodies do not respond efficiently to the insulin. Doctors call this form of the disease *Type II diabetes* (also known as *non-insulin-dependent diabetes*, NIDDM). In Europe and North America, about 80 per

cent of all diabetics have Type II, which is a milder form of the disease. In other parts of the world, more than 95 per cent of all diabetics have Type II.

**Symptoms of diabetes** include excessive urination, great thirst, hunger, and loss of weight and strength. These symptoms may appear gradually—and even be unnoticed—in Type II diabetes. This kind of diabetes is most common in overweight individuals over the age of about 40.

In Type I diabetes, the more serious form of the disease, the symptoms may occur suddenly. Type I diabetes usually strikes young people but can also occur in adults of any age. It hits some people so suddenly that the lack of insulin causes an emergency condition called *diabetic ketoacidosis*. The symptoms of this condition are excessive urination and thirst, loss of appetite, nausea, vomiting, and rapid deep breathing. It is vital that someone with these symptoms receives immediate treatment. If the victim does not receive attention immediately, he or she may go into a state of *diabetic coma*, which can lead to death.

**Cause** of diabetes is unknown. The disease is common in some families, but many diabetics have no known family history of diabetes. Many researchers suspect that certain people inherit a tendency for developing Type II diabetes. Additional factors, such as obesity or severe stress, may trigger the onset of the disease in such people. Some doctors believe that Type I diabetes also involves hereditary traits. These traits possibly cause the body's disease-fighting immune system to respond to certain viral infections by mistakenly attacking the insulin-producing cells of the pancreas.

**Treatment.** Diabetes cannot be cured, but proper treatment can improve a patient's condition considerably. Many diabetics live almost as long as people of normal health.

Type I diabetics need to receive daily doses of insulin. Some patients need more than one dose of insulin each day. To be effective, insulin must be absorbed into the bloodstream. It cannot be administered orally, because it is destroyed in the digestive system. Most diabetics who use insulin receive it by hypodermic injections. A small number of diabetics use portable pumps to inject insulin.

The dosage of insulin prescribed by the doctor depends on the patient's diet and exercising habits. If a diabetic stops taking needed insulin, the amount of glucose in the blood may become excessive. This excess can result in diabetic ketoacidosis, and the patient may go into a diabetic coma.

Most Type I diabetics follow carefully planned diets consisting of planned amounts of carbohydrates, fats, and proteins. Most also test their urine or blood daily for glucose and for *acetone*, a substance produced when the effect of insulin is inadequate. A diabetic follows the planned diet strictly—except if he or she has an *insulin reaction*, or *insulin shock*. This condition occurs when the effect of insulin is so great that the level of sugar in the blood becomes too low. The patient may perspire greatly and become nervous, weak, or even unconscious. The condition can be treated quickly by having the patient eat food that is rich in sugar. Many diabetics carry chocolate or sugar with them in case of an insulin reaction.



Many cases of Type II diabetes can be controlled by a diet that is low in calories. Some Type II diabetics whose condition cannot be controlled by diet alone have to use insulin or take oral drugs that reduce the level of glucose in the blood.

**Complications.** Diabetes can lead to serious complications. For example, it may cause changes in the blood vessels of the retina. This condition is called *diabetic retinopathy*. When this condition is in its advanced stages, it is a major cause of blindness (see **Blindness** [Diseases]). Diabetes is known to cause similar changes in the blood vessels of the kidneys. This condition, called *diabetic nephropathy*, may lead to kidney failure. The nerves may also be affected by diabetes. This complication, known as *diabetic neuropathy*, can result in loss of feeling or abnormal sensations in different parts of the body. Various treatments can control many cases of diabetic retinopathy, diabetic nephropathy, and diabetic neuropathy.

Diabetes can also lead to *atherosclerosis*, a form of *arteriosclerosis* (hardening of the arteries) that may cause a stroke, heart failure, or gangrene (see **Arteriosclerosis**).

**Research.** Scientists are continually searching for ways to control, prevent, and cure diabetes. Since the 1960's, doctors have been experimenting with pancreas transplants and with transplants of the *islets of Langerhans*, the part of the pancreas that produces insulin. Since the 1970's, bioengineers have been working to develop and miniaturize an artificial pancreas. Such a device could continuously measure the amount of glucose in the blood and release either insulin or glucose into the body to maintain a normal level of blood glucose. Other researchers working with the techniques of genetic engineering are trying to identify the hereditary traits that might contribute to diabetes and viruses or other agents that might be responsible for triggering Type I diabetes.

**Diabetes insipidus** is a rare disease in which the kidneys cannot retain water that passes to them from the blood. The patient urinates excessively and becomes extremely thirsty. The disease is caused by a lack of *vasopressin*, a hormone that controls the amount of water leaving the body as urine. Vasopressin is made by the hypothalamus and is stored in and released by the pituitary gland. A disease or injury that affects the hypothalamus or the pituitary gland can cause this condition. Most cases of diabetes insipidus cannot be cured, but the disease can be kept under control by taking vasopressin.

See also **Insulin**; **Hodgkin, Dorothy C.**; **Hypoglycaemia**.

**Diacritical mark** is a sign used with letters of the alphabet to show pronunciation or meaning of words. Diacritical marks are a regular part of spelling in many languages. In English, some words borrowed from other languages use diacritical marks, but the marks are mainly used in dictionaries to show how words are pronounced.

Diacritical marks in English include the *circumflex* (which is written ^ as in ôrder); the *dieresis* (¨ as in fär, rûle); the *macron* (¯ as in äge, èqual, îce, ôpen, üsel); the *tilde* (~ as in càre); the *single dot* (· as in tèrm, pûit); and the *breve* (˘ as in bêd, pîit).

**Diaghilev, Sergei Pavlovich** (1872-1929), was one of the greatest producers and directors in ballet history. He established ballet as a modern theatrical art. Diaghilev changed Europe's ballet scene and created an audience for dance comparable to that for symphonic music.

Diaghilev was born in Novgorod in Russia. From 1899 to 1901, he was artistic adviser for the Maryinsky Theatre in St. Petersburg, Russia. From 1909 to 1929, he directed and produced performances by his own company, the Ballets Russes. At first, he used dancers and *choreographers* (dance composers) from the Russian imperial theatres. Later, he drew from artistic communities elsewhere in Europe, persuading the most innovative artists of the period to collaborate on his ballets.

Diaghilev directed about 80 ballets and operas. Among his company's best-known ballets are *Les Sylphides* (1909), *The Firebird* (1910), *Petrouchka* (1911), *Afternoon of a Faun* (1912), *The Rite of Spring* (1913), *Parade* (1917), and *Apollo* (1928).

See also **Ballet** (Russian ballet); **Stravinsky, Igor**.

**Diagnosis.** See **Disease** (Diagnosing disease); **Medicine** (Diagnosis).

**Dialect** is a variation of a language used by a particular group of speakers. All living languages change through time. Variations in a once uniform speech arise from geographical and social factors. A geographical factor might be a large body of water that separates two groups who originally spoke a language in the same way. For example, speakers of English in the United Kingdom and Australia live very far apart, leading to British and Australian dialects of that language. Social factors might include levels of education, economic status, and, sometimes, ethnic background. All of these factors can produce separate dialects in a large city.

Dialects involve differences in pronunciation and vocabulary. On the basis of such differences, it is possible to identify certain dialects in English. For instance, people in Yorkshire, northern England, in the United Kingdom, might pronounce the word *something* as *summat* and say *pass the glass* using a much shorter *a* than people in the south would do saying the same words. Some Scottish people say *canna* rather than *can't*, for example, and use the word *bairn* when referring to a child. In the Eastern Virginia dialect of the United States, people might pronounce the word *afraid* as *afred*, and call a peanut a *goober*.

Frequently, the term *dialect* implies that there is a standard form of a language that speakers of a dialect do not follow. For example, the French spoken in Paris is considered the standard form of that language. Those people who do not speak Parisian French are said to speak a dialect. But as a variation of the language, Parisian French must also be considered a dialect.

See also **Grammar** (Grammar and usage); **Idiom**; **Language** (Development of language); **Pronunciation**; **Slang**; **Speech**.

**Dialectic.** See **Hegel, G. W. F.** (Hegel's dialectic).

**Dialectical materialism.** See **Materialism**; **Philosophy** (Modern philosophy).

**Dialysis machine.** See **Kidney** (Kidney diseases).

**Diamantina** is one of the rivers of the Lake Eyre system in Australia. It rises in Kirby's Range, in central Queensland, and flows about 900 kilometres through gently sloping country before reaching Goyder's La-



goon, in the northeastern corner of South Australia. It flows only after heavy rainfall in its upper reaches. John McKinlay discovered the river in 1862 and named it *Mueller's Creek*. In 1866, the explorer William Landsborough renamed it *Diamantina*.

**Diameter**, in geometry, is the length of any straight line segment that passes through the centre of a circle or a sphere and touches the figure's boundaries at opposite points. *Diameter* is also the name of such a line segment.

The diameter of a circle or sphere is twice as long as the figure's *radius*. The radius is the length of any line segment that runs from the centre of a circle or a sphere to any point on the figure's boundary. *Radius* is also the name of such a line segment.

The degree of magnification achieved by a microscope or telescope is expressed in *diameters*. For example, a microscope that doubles the apparent size of an object is said to magnify the object by two diameters.

See also **Circle**; **Microscope**; **Sphere**.

**Diamond** is the hardest naturally occurring substance, and also one of the most valuable natural substances. Because of its hardness, the diamond is the most lasting of all gemstones. In Europe, America, and Japan, the diamond is widely used for engagement and wedding rings. Diamonds are also used in industry for cutting, grinding, and boring other hard materials. About half of the world's natural diamonds are suitable only for industrial use. A small percentage of all diamonds mined are set in jewellery.

**What diamonds are.** Diamonds are crystals made up almost entirely of carbon. Some diamond crystals have six faces, but most form *octahedrons*, which have eight faces (see **Octahedron**). Other crystal shapes also occur, some of which are very complex. Natural dia-



**Regent**

The Louvre, Paris  
140.50 carats  
Found in India



**Tiffany**

Tiffany & Company, New York City  
128.51 carats  
Found in South Africa

**Orloff**

Diamond Treasury, Moscow  
189.60 carats  
Found in India



**Earth Star**

Baumgold Brothers, New York City  
111.59 carats  
Found in South Africa



**Condé**

Condé Museum, Chantilly, France  
50 carats  
Found in India



**Cullinan I, or Star of Africa**

British Crown Jewels, London  
530.20 carats  
Found in South Africa



**Hope**

Smithsonian Institution,  
Washington, D.C.  
45.52 carats  
Found in India



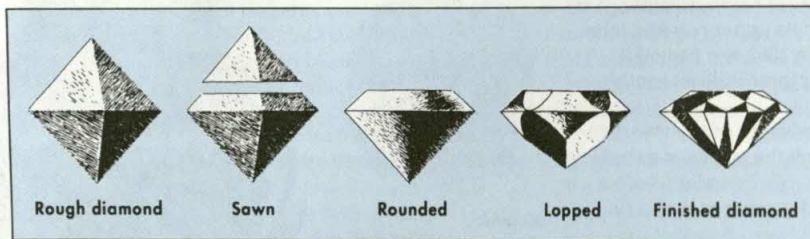
**Koh-i-noor**

British Crown Jewels, London  
108.93 carats  
Found in India



**Diamonds** have been prized throughout history for their beauty and for their extreme hardness. Skilled cutters and polishers can transform rough diamonds, such as those shown above, into brilliant jewels. Some of the world's most famous diamonds are pictured on the right. Each of these diamonds is shown at about three-fourths its actual size.





**Diamond cutting** begins when skilled craftworkers saw a rough diamond in two. They use a thin circular saw that holds diamond dust. The corners are then rounded by rubbing together a spinning diamond and a stationary one. Later, cutters use the *lopping* process to grind *facets* (sides) on the stone. Lopping, *right*, involves carefully pressing the diamond against a rotating wheel coated with diamond dust. Most finished diamonds have 58 facets.



monds probably form in the earth's *upper mantle*—the zone beneath the crust—where high temperature and pressure cause the diamonds to crystallize. The diamonds are later brought to the earth's surface by volcanic activity.

A diamond must be used to cut another diamond. However, a diamond can be cleanly broken with a sharp, accurate blow because of its *cleavage*. Cleavage is a property some minerals have of splitting in certain directions and producing flat, even surfaces. A diamond will not dissolve in acid. But it can be destroyed when it is subjected to intense heat. If a diamond is heated in the presence of oxygen, it will burn and form carbon dioxide. If it is heated without oxygen, a diamond will turn to graphite, a form of carbon so soft that it is used as a lubricant.

**Where natural diamonds are found.** The first diamonds were found thousands of years ago in the sand and gravel deposits of stream beds. Diamonds found in such deposits are called *alluvial diamonds*. The diamond fields of South Africa were discovered in 1867, when a farmer's child found "a pretty pebble" near the banks of the Orange River. The "pebble" proved to be a large diamond. In 1870, diamonds were discovered for the first time in *kimberlite*. This rare rock forms pipe-shaped bodies, which once filled the throats of some volcanoes. A huge diamond deposit was found in 1979 in Western Australia. The Australian diamonds occur in a kind of rock called *lamproite*.

Even in the richest deposits, tons of rock must be mined and crushed to produce one small diamond. Some diamond mines produce about 1 carat (200 milligrams) of diamonds for every 2.7 metric tons of rock

mined. By the late 1980's, the world's diamond mines produced about 90 million carats each year. Australia outranks all other countries in the annual production of natural diamonds. Zaire ranks second. Other leading producers of natural diamonds include Botswana, Russia, and South Africa.

**How diamonds are cut to make jewels.** Diamonds have great power to reflect light, bend rays of light, and break light up into the colours of the rainbow. But to produce the greatest possible brilliance in a diamond, many little *facets* (sides) must be cut and polished on it. Each tiny facet must be exactly the right size and shape and must be placed at exactly the right angle in relation to other facets.

During the 1400's, diamond cutters learned how to shape and polish a stone by using an iron wheel coated with diamond dust. As people learned more about diamonds, they discovered the shapes that give the greatest brilliance. The style of cut often seen today is the round shape with 58 facets, which is called the *brilliant cut*. This style of cutting was begun in the 1600's. Diamond saws cut diamond crystals with great accuracy, and so help prevent waste. See *Gem* (illustration: Types of gem cuts).

**How diamonds can be judged.** Gem diamonds are graded according to weight, clarity, colour, and cut. The weight of a diamond is measured by the carat. The clarity of a diamond can be lessened by various kinds of flaws. Among these flaws are *inclusions* (other substances enclosed in the crystals), small bubbles, and small *fissures* (cracks), which jewellers sometimes call *feathers*. The best-quality diamonds—and the most valuable ones—are completely colourless. Very few dia-



**The size of a diamond** is determined by its weight in carats. One carat equals 200 milligrams. The picture above shows round diamonds of different carats and the approximate difference in their diameters. However, not all diamonds of these weights would have exactly these diameters. For example, a 4-carat diamond deeper than the one shown would have a smaller diameter.



monds reach this standard. Many diamonds have a yellowish tint. Other diamonds are black, blue, brown, green, pink, purple, or red. Red is the rarest colour in natural diamonds. The way a diamond is cut may affect its value because a stone that is not properly proportioned lacks the brilliance of a well-cut stone.

In buying a diamond, the buyer should have the advice of a reliable dealer. Terms used to describe gem diamonds vary considerably. A *flawless diamond* should have no physical defects, such as cracks, inclusions, scratches, blemishes, or a cloudy appearance. But a flawless diamond may not be colourless. Some people consider a diamond to be perfect if it is colourless as well as flawless, has high clarity, and is correctly cut.

Cutting and polishing a rough diamond is a slow and costly process. It must be done by highly trained workers, who take many years to learn their trade.

**Famous diamonds.** Many large diamonds of rare quality are the property of royalty or of a government. The largest stone ever discovered was the *Cullinan*. This diamond, found in 1905 in the Premier mine of South Africa, weighed 3,106 carats, or about 0.6 kilogram. It was purchased by the Transvaal government and presented to King Edward VII of Britain. Transvaal was a British colony in what is now South Africa. Amsterdam cutters *cleaved* (split), cut, and polished the Cullinan into 9 large gems and 96 smaller stones. The largest cut diamond in the world came from the Cullinan. It is the 530-carat *Cullinan I* or *Star of Africa*.

In 1934, the *Jonker* diamond was found. It weighed 726 carats, and was said to be unequalled in purity. Between 1935 and 1937, the Jonker was cut into 12 flawless stones. The largest stone weighed 125 carats. The *Orloff* is a magnificent Russian crown jewel bought by Prince Orloff for the Empress Catherine II. This huge diamond is said to have been stolen from the eye of an idol in a Hindu temple. The *Koh-i-noor*, now in the British crown jewels, was for many centuries possessed by Indian and Persian rulers. Great Britain acquired it when the British annexed the Punjab in 1849.

The *Regent* diamond, once known as the *Pitt* diamond, is an Indian gem regarded as one of the most

beautifully cut of the world's large diamonds. It is owned by the government of France and is on display in the Louvre Museum in Paris. The blue *Hope* diamond became the property of the Smithsonian Institution in the United States in 1958.

**Industrial uses.** Diamonds unsuitable for cutting into gemstones are widely used in industry. Industrial-grade diamonds include stones that are imperfectly formed, contain many inclusions or other flaws, or have poor colour. Manufacturers need these diamonds to shape, with great accuracy, hard metals that are used in making cars, aeroplanes, and various types of engines and other machinery. Diamonds are used in such work because of their extreme hardness. They can cut, grind, and bore very hard metal quickly and accurately. Sometimes whole rough diamonds are set into industrial tools. Sometimes the diamonds are crushed and then baked onto cutting tools. Occasionally, diamonds are cut into special shapes before they are set into tools. Diamonds are set in the ends of drills used in mining. Very fine wire is drawn to size through diamonds in which tapering holes have been cut. A diamond *stylus* (needle) is used in most record players.

**Synthetic diamonds.** The demand for industrial diamonds cannot be met by the supply of natural diamonds. For this reason, industry now depends on synthetic diamonds. The world's first synthetic diamond was produced in 1954 at the General Electric Research Laboratory. Scientists at the laboratory made the diamond by compressing carbon under extremely high pressure and heat. Today, several companies manufacture industrial diamonds.

In 1970, the General Electric Company produced the first synthetic diamonds of gem quality and size. Scientists use these gem-sized diamonds to research new uses for diamonds. For example, researchers have found that adding small amounts of the chemical element boron to synthetic diamonds turns them into *semiconductors*. Semiconductors are materials with special electrical properties. They are used to make transistors and other electronic equipment. Synthetic diamonds are not sold as jewellery because they cost so much to produce



**Synthetic diamonds** are produced in a press, *left*, developed by scientists in the early 1970s. Synthetic-diamond powder, *centre*, is placed in the press along with a metal catalyst. The mixture then is subjected to extreme heat and pressure. The diamonds that result, *right*, have the quality and size of natural gems.



that, as gems, they would cost even more than natural diamonds.

**Imitation diamonds** are gems that resemble genuine diamonds. Some are natural gemstones, such as colourless varieties of spinel and zircon. Others do not occur in nature and are manufactured from substances that are similar to diamonds in appearance. These substances include glass, strontium titanate, yttrium aluminium garnet (YAG), and cubic zirconia. A cubic zirconia is difficult to distinguish from a genuine diamond. Jewellers must use scientific tests to tell them apart. Imitation diamonds are softer than genuine diamonds and may eventually show scratches and signs of wear.

See also **Borazon; Gem; Hardness.**

**Diana** was a goddess in Roman mythology. She was the daughter of Jupiter, the king of the gods, and the goddess Latona. Diana and the god Apollo were twins. She was born on the island of Delos, and so the ancient Romans sometimes called her the Delian goddess, or Delia. She resembled the Greek goddess Artemis.

Diana was a moon goddess and the goddess of various aspects of women's life, including childbirth. She also was the goddess of young living things, particularly young animals, and of hunting. Diana symbolized chastity and modesty. She was a virgin and demanded that all her attendants be virgins. Artists showed the goddess wearing hunting clothes, carrying a bow and arrows, and accompanied by forest nymphs and hunting dogs.

See also **Artemis.**

**Diana, Princess of Wales** (1961- ), is a member of the British royal family and the wife of the Prince of Wales (see **Charles, Prince**). She is the mother of Prince William of Wales and Prince Henry of Wales. In 1992, the Prince and Princess of Wales announced their separation.

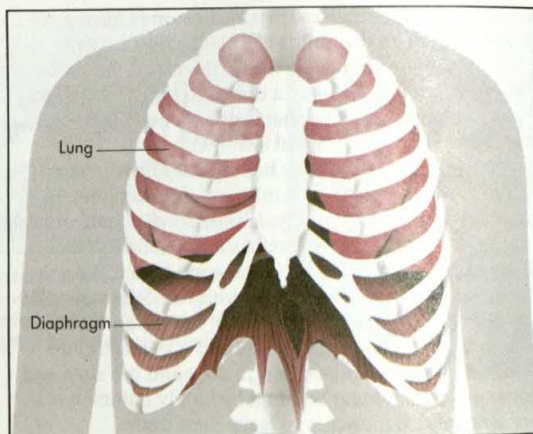
The Princess of Wales was born Lady Diana Spencer on July 1, 1961, at Park House, on the royal estate of Sandringham, in Norfolk, England. Her father, the Eighth Earl Spencer, was once an *equerry* (household official in charge of forces) to King George VI. The Princess of Wales was educated at West Heath School, Kent, and in Switzerland. She worked at a kindergarten in Pimlico, London, before her marriage to Prince Charles in 1981.

The Princess of Wales attends public functions as part of her royal duties. She is also *patron* (chief supporter) of several charities, including the Malcolm Sargent Cancer Fund for Children.

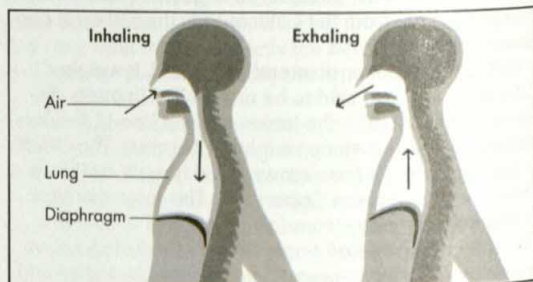
**Diaphragm**, the large muscle attached to the lower ribs, separates the chest from the abdomen. Only human beings and other mammals have complete diaphragms. The diaphragm is the chief muscle used in breathing. It is shaped like a dome.

When a person takes a breath, the diaphragm contracts and moves downward. This increases the space in the chest. At the same time, muscles attached to the ribs cause the ribs to move outward. This expands the chest, and together with the downward motion of the diaphragm, creates a slight vacuum in the chest. The vacuum causes air to enter the lungs through the windpipe. This action is called *inspiration* or *inhalation*.

During *expiration*, also called *exhalation*, air moves out of the lungs as the diaphragm and rib muscles relax. When a person breathes normally, expiration is passive and muscles do no work. The expanded lung contains



The **diaphragm** is a large, dome-shaped muscle that plays a major role in respiration. It is attached to the ribs on each side and to the breastbone in front and the lower spine at the back. *above*. When a person inhales, *below left*, the diaphragm contracts and its dome flattens. This action increases the volume of the lungs, thereby creating a slight vacuum that pulls air into the lungs. When a person exhales, *below right*, the diaphragm and rib muscles relax. The stretched elastic fibres in the lung contract and cause the lung to become smaller, forcing air out.



elastic fibres that were stretched during inspiration. This elastic tissue behaves like stretched rubber bands, causing the lung to contract like a deflating balloon. This forces air out of the chest. The lung gets smaller until it reaches the size at which the breath started. The lungs do not empty completely during expiration because the chest wall holds them in a partly expanded state. In heavy breathing, as occurs during exercise, expiration is active. Another set of rib muscles helps to make the chest smaller. Muscles in the abdominal wall also contract to push the abdominal organs upward against the diaphragm, helping to force air out of the lungs.

The *phrenic nerve* carries the electrical signals to the diaphragm that stimulate it to contract. This nerve arises from the spinal cord high in the neck and extends into the chest down to the diaphragm.

See also **Abdomen; Chest; Lung; Respiration.**

**Diarrhoea** is a condition characterized by loose and frequent bowel movements. The stools are usually watery and soft, and may contain mucus, pus, or blood. Nausea, loss of bowel control, and abdominal cramps frequently accompany diarrhoea.

Diarrhoea is usually a symptom of an intestinal disorder and not a disease itself. The most frequent cause of



diarrhoea is infection from food or water contaminated by viruses, bacteria, or protozoans. The body usually develops a defence against the invading agent, and diarrhoea then disappears. However, diarrhoea may become chronic and lead to dehydration, malnutrition, vitamin deficiencies, and a weakened immune system. Such infectious diarrhoea is epidemic in many developing countries. Every year, dehydration resulting from infectious diarrhoea kills millions of children worldwide. Other causes of diarrhoea include *colitis* (inflammation of the colon) and intestinal cancer. Emotional disturbances, such as nervousness or fear, can also bring on diarrhoea.

Treatment of diarrhoea consists primarily of replacing lost body fluids and salts. A doctor should be consulted if diarrhoea persists for more than a few days, or if it afflicts infants or young children, the elderly, or the severely ill.

See also **Cholera; Colitis; Dehydration; Dysentery.**

**Diary** is a written account of a person's experiences and thoughts, recorded each day or every few days. Many people keep diaries as a personal record. Most do not intend that other people read their diaries.

Diaries resemble journals, and the two words are often used interchangeably. However, journals are generally less personal than diaries, and many journals are written for other people to read.

Throughout history, people have kept diaries. Some diaries provide insight into the events and customs of a particular period. One of the most famous historical diaries was written by Samuel Pepys, a British government official. Pepys's diary, written in a personal code, covers the period from 1660 to 1669. Pepys was a sociable, prosperous Londoner who made keen observations about public events. His diary includes information on the Great Plague of 1665 and the Great Fire of London, which occurred in 1666. Pepys's diary was not decoded until the early 1800's. The complete diary was first published in nine volumes during the 1970's.

The diary of William Byrd II, a wealthy American landowner in colonial Virginia, vividly portrays the lives of well-to-do colonists during the 1700's. Perhaps the best-known diary of the 1900's was written by Anne Frank, a young German-Jewish girl. She and her family hid from the Nazis during World War II to avoid persecution. From 1942 to 1944, Frank kept a record of her experiences, thoughts, and fears. *The Diary of Anne Frank* (1947) provides a moving personal account of the sufferings of Jews during the war.

Many authors of fiction have written novels and short stories in the form of diaries. Such tales have a highly personal quality because the reader can become closely involved with the personality of the central character. The Russian author Nikolai Gogol wrote "The Diary of a Madman" (1835), a short story in the form of the diary of a clerk. In the novel *Dangling Man* (1944), the American author Saul Bellow portrays the hero of the story in the act of writing a diary. The novel consists largely of the hero's diary entries.

See also **Bellow, Saul; Burney, Fanny; Byrd (William II); Evelyn, John; Frank, Anne; Pepys, Samuel.**

**Dias, Bartolomeu** (1450?-1500), also spelled *Diaz*, was a Portuguese sea captain and explorer. His discovery of a sailing route around Africa helped establish

travel between western Europe and Asia.

Little is known about Dias' early life. In 1481 and 1482, he commanded one of the ships in an expedition to the Gold Coast in Africa, now Ghana.

In 1487, King John II of Portugal ordered Dias to try to sail to the southern end of Africa. The king wanted to know if ships could reach Asia by sailing around Africa. He had earlier ordered land and sea expeditions to travel to Asia, but those attempts at the journey failed.

Dias commanded a fleet of three ships that left Portugal in the summer of 1487. After reaching the mouth of the Orange River in southern Africa, a storm blew the ships out to sea. Dias and his crews did not see land for 13 days. When the storm ended, he realized that the ships had been blown around the southern tip of Africa. He sailed along the southeast shore of the continent, hoping to continue on to India. However, the men were exhausted by their long voyage, and their food supply was running low. They persuaded Dias to return to Portugal. As the expedition sailed around the tip of Africa toward Portugal, Dias sighted what is now called the Cape of Good Hope. According to tradition, he named it the *Cape of Storms*. However, King John later renamed it the Cape of Good Hope because its discovery indicated that a sea route to India would soon be found. The expedition reached Portugal in December 1488.

In 1494, Dias directed the construction of two ships for what became the first successful expedition around Africa to India. Vasco da Gama, another Portuguese explorer, led the voyage in 1497. In 1500, Dias commanded four ships in an expedition led by Pedro Álvares Cabral, also a Portuguese adventurer. Cabral's expedition consisted of 13 ships. He tried to follow da Gama's route to India, but the fleet drifted off course and reached what is now Brazil. Dias died during the voyage from Brazil when a storm sank his ship.

See also **Da Gama, Vasco; Exploration** (map: The great age of discovery).

**Diaspora.** See **Jews** (Invasions and conquests).

**Diathermy** is a method of treating muscle and joint disorders and other diseases by creating heat energy in tissues beneath the skin. Diathermy is used chiefly to relieve such conditions as muscle aches, muscle strain, and pain and inflammation in the joints.

In diathermy, an electric current is passed through the body, generating an electromagnetic field. The tissues of the body have different resistances to the flow of electric current. This resistance causes a temperature rise in the tissues. At the same time, the tissues absorb the electromagnetic field, causing molecules in the tissues to *oscillate* (move back and forth). The oscillation of the molecules generates heat energy. It is this energy that affects the tissues, resulting in healing, relaxation of the muscles, or other therapeutic effects.

The electric current used in diathermy is an oscillating current with very high frequencies. The current oscillates so rapidly that the patient does not feel any shock. There are several forms of diathermy, each having a different range of frequencies. All forms of diathermy used for therapeutic purposes are known as *medical diathermy*. *Short-wave diathermy*, with frequencies in the range of radio waves, is the most commonly used form of medical diathermy. This diathermy is usually applied with two insulated metal plates, which fit





A **diathermy machine** uses electric current to create heat energy in tissues beneath the skin, producing therapeutic effects.

against the part of the body treated. *Surgical diathermy* is used to destroy tumours and other abnormal growths. The current is concentrated at the point of a fine wire, with sufficient heat generated to kill the tissue.

**Diatom** is a microscopic, single-celled organism. Diatoms are found in the ocean, in freshwater lakes, rivers, and streams, and on moist soil. In water, diatoms live attached to rocks, sand, or plants, or they may float freely. Diatoms are probably best known as part of the mass of drifting organisms in the upper regions of oceans. These organisms are called *plankton*.

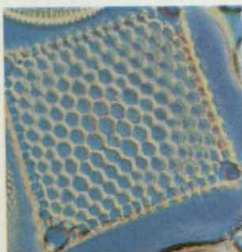
Diatoms belong to a group of simple plantlike organisms called *algae*. Like green plants, diatoms can live and grow using only sunlight, water, carbon dioxide, and certain minerals.

Diatom cells contain both green and yellow-orange pigments that enable them to trap the sun's energy. This combination of pigments gives diatoms a golden-brown colour. For this reason, they are sometimes called *golden-brown algae*.

Diatoms differ from other algae in that their cells are enclosed in a hard, glasslike shell made of opal. The



**Diatom shells** show some of the many possible shapes of the one-celled plants. The edgewise view above illustrates how the two halves of a diatom shell fit together. The photographs below show flat views of a square and a five-pointed diatom.



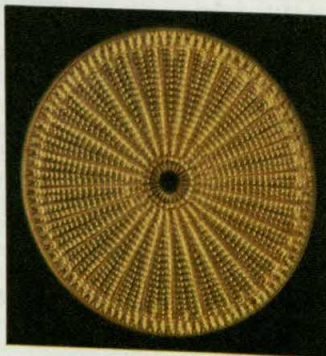
shell, also called the *frustule*, consists of two parts that fit one inside the other, like a box with its lid. Most diatoms are either circular or oblong in shape. Diatoms usually multiply through cell division—that is, one cell divides into two cells. After a diatom cell divides, each new cell retains one part of the parent shell and builds a new part to fit into it. Some diatoms stay linked after cell division, forming chain- or ribbon-shaped colonies.

Some scientists have estimated that there may be more than 12,000 species of diatoms. Scientists identify species by examining the shells.

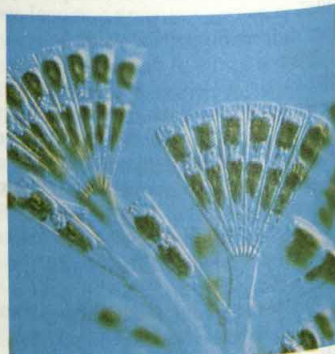
Planktonic diatoms are especially plentiful in certain regions of the oceans, where they serve as an important source of food for fish and other marine animals. When diatoms die, their hard shells remain intact. Eventually the shells sink to the bottom of the sea. Over thousands of years, the layer of diatom shells may become very deep. On land, the accumulation of diatom shells from ancient seabeds is mined as *diatomaceous earth*, also called *diatomite*. This substance is used as a polishing powder, abrasive, insulator, or filter. It is also used as a filler in paints and in rubber and plastic products.



**Chaetoceros diatoms** link themselves together into chains.



An **Arachnoidiscus diatom** is flat and has a circular shape.



Freshwater **meridion diatoms** join and form a delicate fanlike pattern.



**Scientific classification.** Diatoms have traditionally been classified in the plant kingdom, Plantae. Many scientists now classify diatoms in the kingdom Protista.

See also **Algae**; **Plankton**.

**Diaz, Bartolomeu.** See **Dias, Bartolomeu**.

**Diaz, Porfirio** (1830-1915), served two terms as president of Mexico from 1877 to 1880 and from 1884 to 1911.

Diaz gained fame as a general in the war against the United States from 1846 to 1848 and in the war against French invaders that lasted from 1863 to 1867. Overthrowing President Lerdo de Tejada in 1876, Diaz acted as provisional president until his election in 1877. His policies encouraged railways, large-scale agriculture, banking, and industry. However, conditions improved little for most people. A popular uprising in 1910 forced Diaz into exile in France, where he died. Diaz was born in Oaxaca, Mexico.

See also **Mexico** (The dictatorship of Porfirio Diaz).

**Dice** are small cubes used in such games of chance as craps. Dice are also used in playing backgammon, Monopoly, and other board games. A single cube is called a *die*. Each die has six sides, with each side imprinted with one to six dots. In most games, two dice are used. Players roll the dice on a craps table or other flat surface. When the dice stop rolling, the total number of dots on the top side of both dice determines the number used for that particular turn. Random chance de-



Dice are used in games of both chance and skill. In many games, they determine the number of moves a player may take.

cides which of the numbers appear and skill is not involved.

Craps is a popular gambling game in the United States in which a player rolls the dice, trying for a certain number from 2 to 12, depending on the situation. There are 36 combinations of numbers that will produce one of the 11 numbers from 2 to 12.

**Dichloro-diphenyl-trichloroethane.** See **DDT**.

**Dick, Sir William Reid** (1879-1961), was a skilful British portrait painter and sculptor who was noted for his deep insight into character. Among his best-known portraits are those of King George VI; Queen Elizabeth, the Queen Mother; Princess Elizabeth (now Queen Elizabeth II); and Sir Winston Churchill. Among his best-known statues are those of King George V, Franklin D. Roosevelt, and David Livingstone. Dick was also the sculptor of the statue of Lady Godiva on horseback, which is at Coventry, England. Dick was born in Glasgow in Scotland, and educated at the School of Art there. He was elected a member of the Royal Academy in 1928 and knighted in 1935.



**Dickcissels** are small birds that live along sides of roads and railways in the central United States. The birds have greyish-brown feathers and a yellow breast.

**Dickcissel** is a bunting of the finch and sparrow family (see **Bunting**). The dickcissel is a bird about 15 centimetres long. It has a streaked greyish-brown plumage, with a yellow breast and bright chestnut wing patches. There is a black crescent on the throat. Dickcissels are common in the central United States, and are sometimes seen in the eastern states. They live along sides of roads and railways. The birds eat insects and seeds. The female lays from 3 to 5 eggs. The nest is built of leaves, grass, and hair, and is on or near the ground.

**Scientific classification.** The dickcissel belongs to the New World seedeater family, Fringillidae. The bird is *Spiza americana*.

**Dickens, Charles** (1812-1870), was a great English novelist and one of the most popular writers of all time. His best-known books include *A Christmas Carol*, *David Copperfield*, *Great Expectations*, *Oliver Twist*, *The Pickwick Papers*, and *A Tale of Two Cities*. Dickens created some of the most famous characters in English literature. He also created scenes and descriptions of places that have long delighted readers. Dickens was a keen observer of life and had a great understanding of humanity, especially of young people. He sympathized with the poor and helpless, and mocked and criticized the selfish, the greedy, and the cruel.

Dickens was also a wonderfully inventive comic artist. The warmth and humour of his personality appear in all his works. Perhaps in no other large body of fiction does the reader receive so strong and agreeable an impression of the person behind the story.

### Dickens' life

Charles John Huffam Dickens was born in Portsmouth on Feb. 7, 1812. He moved with his family to London when he was about two years old. Many of the events and people in his books are based on events and people in his life. Dickens' father, John Dickens, was a poor and easygoing clerk who worked for the navy. John served in some respects as the model for Wilkins Micawber in *David Copperfield*. He spent time in prison





**Charles Dickens**, the most famous English writer of his time, enchanted audiences with dramatic readings from his novels.

for debt, an event Charles re-created in *Little Dorrit*.

Even when John was free, he lacked the money to support his family adequately. At the age of 12, Charles worked in a London factory pasting labels on bottles of shoe polish. He held the job only a few months, but the misery of that experience remained with him all his life.

Dickens attended school off and on until he was 15, and then left for good. He enjoyed reading and was especially fond of adventure stories, fairy tales, and novels. He was influenced by such earlier English writers as William Shakespeare, Tobias Smollett, and Henry Fielding. However, most of the knowledge he later used as an author came from his observation of life around him.

Dickens became a newspaper reporter in the late 1820s. He specialized in covering debates in Parliament, and also wrote feature articles. His work as a reporter sharpened his naturally keen ear for conversation and helped develop his skill in portraying his characters' speech realistically. It also increased his ability to observe and to write swiftly and clearly. Dickens' first book, *Sketches by Boz* (1836), consisted of articles he wrote for the *London Evening Chronicle*. These descriptions, fictional portraits, and short stories surveyed the manners and conditions of the time.

**Literary success.** Dickens won his first literary fame with *The Posthumous Papers of the Pickwick Club*. Published in monthly parts in 1836 and 1837, the book describes the humorous adventures and misadventures of a group of slightly eccentric characters in London and the English countryside. After a slow start, *The Pickwick Papers*—as the book is usually called—gained a popularity seldom matched in the history of literature. At 24, Dickens suddenly found himself famous. He remained so until his death.

Dickens founded and edited two highly successful weekly magazines. He edited *Household Words* from 1850 to 1859 and *All the Year Round* from 1859 to his death. As a public figure, Dickens was constantly in the

news, and was recognized and honoured wherever he went. He was famous in America as well as in Britain, and he toured the United States in 1842 and in 1867 and 1868.

**Personal life.** Personal unhappiness marred Dickens' public success. In 1836, he married Catherine Hogarth. Catherine had a sister Mary, who died in 1837. Dickens' grief at Mary's death has led some scholars to believe that he loved Mary more than his wife. Catherine was a good woman but lacked great intelligence. She and Dickens had 10 children. The couple separated in 1858.

Dickens had remarkable mental and physical energy. He recorded his activities in thousands of letters, many of which make delightful reading. He spent much of his crowded social life with friends from the worlds of art and literature. Dickens enjoyed drama and went to the theatre as often as he could. When he was rich and famous, he made a hobby of producing and acting in amateur theatrical productions. He had great success giving public readings of his works. Dickens' gift for creating dramatic scenes in his novels can be traced to his love for the theatre.

Besides writing, editing, and touring as a dramatic reader, Dickens busied himself with various charities. These charities included schools for poor children and a loan society to enable the poor to move to Australia. Dickens often walked for hours to work off his remaining energy. He came to know the streets and alleys of London better, perhaps, than any other person of his time.

Dickens' health began to decline about 1865 and he died of a stroke on June 9, 1870.

### Dickens' books

Dickens wrote 20 novels (including 5 short Christmas books), and many sketches, travel books, and other non-fiction works. Not all of his books were best sellers, but the most popular ones broke all sales records for the time. Most of his novels were published in sections.

**The first phase.** After the success of *The Pickwick Papers*, Dickens turned to more serious themes and plots. However, he always introduced enough humour to keep his books entertaining.

*Oliver Twist* (1837-1839) describes the adventures of a poor orphan boy. The book was noted for its sensational presentation of London's criminal world and for its attack on England's mistreatment of the poor.

In *Nicholas Nickleby* (1838-1839), Dickens criticized greedy proprietors of private schools, who treated students brutally and taught them nothing.

*The Old Curiosity Shop* (1840-1841) is less respected today than when it was first published, largely because the death scene of Little Nell seems sentimental to modern tastes.

*Barnaby Rudge* (1841) is a historical novel that deals with a series of riots in London in 1780. *Martin Chuzzlewit* (1843-1844) is one of two books that Dickens based on his first trip to America. The other is the travel book *American Notes* (1842). Dickens intended *Martin Chuzzlewit* to be a study of many forms of selfishness. But it is best known for its unflattering picture of the crudeness of American manners and for its comic characters. Two of its finest creations are the hypocrite Pecksniff and the chattering, alcoholic midwife Sairey Gamp.



Dickens wrote his five "Christmas books" during the 1840's. The first, *A Christmas Carol* (1843), is one of the most famous stories ever written. In the book, three ghosts show the old miser Ebenezer Scrooge his past, present, and future. Realizing that he has been living a life of greed, Scrooge changes into a warm and unselfish person. The other Christmas books are *The Chimes* (1844), *The Cricket on the Hearth* (1845), *The Battle of Life* (1846), and *The Haunted Man* (1848).

**The second phase.** During the 1840's, Dickens' view of Victorian society, and perhaps of the world, grew darker. His humour became more bitter, often taking the form of biting satire. His characters and plots seemed to emphasize the evil side of human experience.

At the same time, Dickens increasingly refined his art. The range of his tone widened and he paid more attention to structure and arrangement. He turned to symbolic themes to help express and expand his observations on topical political and social issues and on larger matters of morality and values. The unhealthy London fog in *Bleak House*, for example, symbolizes the illness of society, especially its lack of responsibility toward the downtrodden and the unfortunate.

*Dombey and Son* (1846-1848) deals primarily with a selfish egotist whose pride cuts him off from the warmth of human love. The book stresses the evils of the Victorian admiration for money. Dickens believed that money had become the measure of all personal relations and the goal of all ambition.

With *David Copperfield* (1849-1850), Dickens temporarily lessened the role of social criticism to concentrate more on semiautobiography. The novel describes a young man's discovery of the realities of adult life. David's youth is clearly patterned after Dickens' youth.

*Bleak House* (1852-1853) is in many respects Dickens'

greatest novel. It has a complex structure and many levels of meaning, mixing melodrama with satire and social commentary. The book deals with many social evils, chiefly wasteful and cruel legal processes. It also attacks the neglect of the poor, false humanitarians and clergymen, and poor sanitation.

This long novel was followed by the much shorter and simpler *Hard Times* (1854). *Hard Times* attacks philosopher Jeremy Bentham's doctrine of *utilitarianism*. Bentham believed that all human ideas, actions, and institutions should be judged by their usefulness. Dickens was convinced that Bentham reduced social relations to problems of cold, mechanical self-interest.

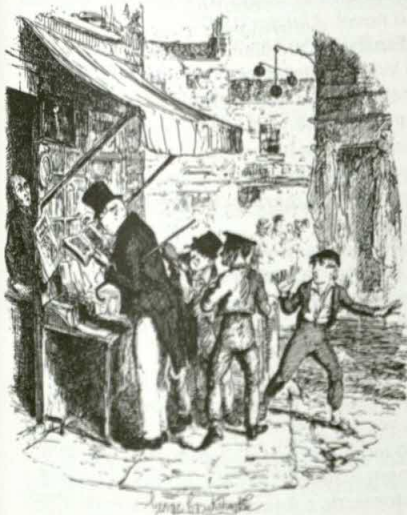
In *Little Dorrit* (1855-1857), Dickens continued his campaign against materialism and snobbery, which were represented by the rich Merdle family and their social-climbing friends. He also ridiculed government inefficiency in the form of the "Circumlocution Office." The prison, like the fog in *Bleak House*, is symbolic. It stands for the painful conditions of life in a materialistic, decaying society.

*A Tale of Two Cities* (1859) was the second of Dickens' two historical novels. It is set in London and Paris and tells of the heroism of fictional Sidney Carton during the French Revolution.

In *Great Expectations* (1860-1861), Dickens returned to the theme of a youth's discovery of the realities of life. An unknown person provides the young hero Pip with money so that Pip can live as a gentleman. Pip's pride is shattered when he learns the source of his "great expectations." Only by painfully revising his values does Pip reestablish his life on a foundation of sympathy, rather than on vanity, possessions, and social position.

*Our Mutual Friend* (1864-1865) was Dickens' final novel of social criticism. Dickens again attacked the false

*Oliver Twist* and *David Copperfield* contain many popular Dickens characters. In *Oliver Twist*, left, an original illustration by the artist George Cruikshank shows Oliver watching in alarm as the Artful Dodger and Charley Bates pick Mr. Brownlow's pocket. In *David Copperfield*, right, David, Betsy Trotwood, and Mr. Dick watch the joyful reunion of Wilkins Micawber and his family. Hablot Knight Browne, popularly known as Phiz, drew this illustration for the first edition of the novel.





values of the newly rich. He satirized greed, using the great rubbish heaps of the London dumps as a symbol of filthy money. The novel is also notable for its suggestive use of London's River Thames.

Dickens had completed about one-third of his novel *The Mystery of Edwin Drood* when he died. Nobody knows how Dickens intended the story to end. Scholars and readers throughout the years have proposed many possible solutions for the mystery.

### Dickens' place in literature

Dickens is now considered one of the major figures in English literature, but his position was not always so high. His reputation declined between 1880 and 1940. This was partly due to the psychological emphasis that became fashionable in novels after Dickens' death. Critics valued Dickens chiefly as an entertainer and, above all, as a creator of a huge gallery of comic, pleasant, and villainous characters. They recognized him as a master creator of plot and scene, and as a sharp-eyed observer of London life. But they considered his outlook simple and unrealistic. They believed he lacked artistic taste and relied too much on broad comedy, dramatic effects, sentimentality, and superficial psychology.

However, since 1940, numerous books and essays have described Dickens as a writer of considerable depth and complexity. He has also been praised as a sensitive and philosophic observer of human struggles within social institutions. In this sense, Dickens has been associated with such authors as Herman Melville, Franz Kafka, and Fyodor Dostoevsky.

Recent criticism has demonstrated that Dickens can no longer be regarded only as an entertainer, though his ability to entertain is probably the major reason for his popularity. Whatever his other claims to greatness may be, Dickens ranks as a superbly inventive comic artist. His characters have been compared to those of Shakespeare in their variety, colour, energy, and life. Dickens was aware of human evil, but he never lost his

perspective. His art was sustained by an awareness and appreciation of the human comedy.

**Dickerson, Bob** (1924- ), an Australian painter, became famous for his paint and charcoal works based on social themes. His early career as a professional boxer left Dickerson with a keen appreciation for physical fitness. But it also left psychological scars caused by what he described as "the cruellest life on earth."

Dickerson's work shows his interest in underprivileged and dispossessed people. He often expressed this interest in paintings of single figures. The figure of a man sitting on a park bench, sleeping in a corner, or simply staring straight out of the canvas develops great eloquence in a typical Dickerson painting or drawing. He adapts the blocky forms, straight lines, and angular shapes of cubism to present his themes in the strongest possible way, and he paints primarily from his emotions. The simplicity of his outlook and methods adds greatly to the power of the final result.

Robert Henry Dickerson was born in the Sydney suburb of Hurstville. He left school at the age of 14 and had no formal art training.

**Dickey, James** (1923- ), is an American poet and novelist. He is known chiefly for works that portray people testing their survival instincts against other people and nature. Some of his writings explore people's animal instincts, which include killing for enjoyment. Dickey writes in a clear, matter-of-fact style that shows people learning about the brutal side of human nature.

Dickey's novel *Deliverance* (1970) tells about a middle-class businessman who must struggle to survive in the wilderness. In his fight to survive, he has to kill another man. This experience teaches him that cruelty is part of people's nature. Many of Dickey's writings are based on episodes from his own life. Some of his works, particularly the poem "The Firebombing" (1964), reflect his experiences as a combat pilot. The pilot in this poem feels a sense of power at killing, but no sorrow.

Dickey was born in Atlanta, Georgia. He won the National Book Award for poetry in 1966 for his collection *Buckdancer's Choice* (1965). His other collections include *Poems 1957-1967* (1967) and *The Strength of Fields* (1980). A number of his prose pieces were published in *Sortes: Journals and New Essays* (1971). Dickey also wrote a second novel, *Alnilam* (1987).

**Dickinson, Emily** (1830-1886), was an American poet. Dickinson and Walt Whitman are considered the two most gifted poets in American literature. Like Whitman, she was influenced by the writings of American author Ralph Waldo Emerson. In her verses, Dickinson expressed Emerson's late pessimism. Many of her poems reflect the alienation of American intellectuals after the Civil War (1861-1865).

**Her life.** Emily Dickinson was born in Amherst, Massachusetts, on Dec. 10, 1830. She was reclusive, and much about her is unknown. She never married, and after turning 30, seldom saw anyone other than her immediate family.

Dickinson's seclusion from society has fascinated her readers. Scholars believe that she chose to think and write in, as she wrote, "her own Society," rather than in the narrow-minded literary establishment of her time. This establishment expected female writers to confine themselves to domestic subjects and sentimental obser-

**The study,** shown here, at Charles Dickens' birthplace in Portsmouth is preserved as a monument to the outstanding author.





ventions. Furthermore, an unmarried professional woman in America had few opportunities in the 1800's. Therefore, Dickinson chose to remain in her comfortable, upper-middle-class home. Although her choice no longer seems so strange, people in her town viewed her as a curiosity and finally resented her unavailability.



Emily Dickinson

Dickinson always wrote as what she called the "supposed person." This person never tired of examining the unique facts of existence. Hidden away on the second storey of her parents' home, she analysed practically every aspect of nature in poems that she began to bind into small books that were called *fascicles*.

At about the age of 30, Dickinson began to look intensely at life itself, rather than looking for the normal expectations of life. While the Civil War raged, she produced the most and best of her poems. The poet continued to write in the 1870's but at a much slower pace. Probably one of her best poems, however, was written in this period of decline. Called "A Route of Evanescence," it describes the fluttering ascent of a hummingbird. For Dickinson, this erratic ascent was also the route of experience. Life was finally inscrutable, and its joy was to be found in studying its paradoxes.

**Her poems.** Dickinson wrote over 1,700 poems, but scholars generally agree she did not wish to publish any of them. But at least 10 of her poems appeared in print during her lifetime without her permission. One of them, "Success Is Counted Sweetest," teaches that experience resides in the ratio between success and failure rather than in either of the two exclusively.

The mere experience of being alive dominates Dickinson's poetry. Her poems show how Dickinson was sensitive to both the ecstasy and the anguish of everyday experience. In "A Narrow Fellow in the Grass" her crisp imagery conveys the sudden and flashing fear of coming upon a snake in the tall grass:

Yet when a Boy, and Barefoot—  
I more than once at Noon  
Have passed, I thought, a Whip lash  
Unbraiding in the Sun

Dickinson daily dressed in white, as if to mock the traditions of marriage. She often pondered the consequences of her life style:

I'm "Wife"—I've finished that—  
That other state—  
I'm Czar—I'm "Woman" now—  
It's safer so—

The "lover" in many of her poems is not a potential husband and "master" but death and eternity. In what many critics believe is her greatest poem, "Because I Could Not Stop for Death," a carriage that brings her gentleman caller holds "but just Ourselves/And Immortality."

The point of view of most of her poems reinforces her theme that our most important moments are over as soon as they begin. Dickinson's "I Heard a Fly Buzz" reflects this theme, describing with beauty and simplicity a dying person's impressions at the moment of death. This poem appears in the **Poetry** article.

Often her poems open with a clear story line, but quickly fade at their close into silence, as if to suggest her inquiry continues in the subconscious. As she wrote in another poem, it was the poet's job to distil "amazing sense/from ordinary meaning."

See also **American literature** (picture).

**Dickinson, Goldsworthy Lowes** (1862-1932), a British humanist and author, wrote many works on historical and philosophical subjects. He was a pacifist and wrote several books against war and anarchy. He was dedicated to the cause of international peace and did much work towards the foundation of the League of Nations. His works include *The Development of Parliament in the Nineteenth Century* (1895), *The Greek View of Life* (1896), *Letters from John Chinaman* (1901), *Justice and Liberty* (1908), *Religion and Immortality* (1911), and *The International Anarchy* (1926).

Dickinson was born in London, and he was educated at Charterhouse and King's College, Cambridge. He later taught political science at Cambridge and London universities.

**Dicotyledon** is a type of flowering plant that has two *cotyledons* (leafy parts within each seed). Dicotyledon plants have leaves with netted veins. Their flower petals usually grow in multiples of 4 or 5. Common dicotyledons include beans, peas, marrows, and tomatoes. See also **Cotyledon**.

**Dictating machine** is a business machine that records speech on a magnetic disc, tape, or other device. The recording can then be played back and copied, generally in typed form. Dictating machines save time because a person can dictate at any time without calling a shorthand typist. Some machines are lightweight and small enough to be carried easily on business trips.

A dictating machine has either a built-in microphone or a separate microphone that plugs into it. The person dictating speaks into the microphone. The speech is recorded on a variety of materials, including plastic belts, cartridges, discs, and tapes. Cassette tapes are most widely used. To play back the dictation, a typist places the recording in a device called a *transcriber* and listens to it through earphones. Some dictating machines have a built-in transcriber. Others use a separate unit.

A centralized dictating system allows people to dictate from different locations to a central office. With this system, the person dictating may use a regular telephone or a special microphone that is connected to telephone lines.

**Dictatorship** is a form of government in which an individual, a committee, or a group holds absolute power. The term *dictator* originated in ancient Rome. The Roman Senate often appointed individuals as temporary "dictators" who could handle national emergencies without the approval of the people or the Senate. The Roman dictator, however, did not have the absolute power of modern dictators. Today, many countries are ruled by dictatorships.

Dictatorship is similar to *absolute monarchy*, another



system of government in which the rulers have no legal restrictions on their power. However, the two systems differ. Throughout history, most people have accepted monarchies as a form of government. Once established, monarchies tended to become hereditary. Most monarchs respected the established customs and institutions of countries they ruled and often shared power with other government officials and nobles. Dictatorships, on the other hand, generally lack the approval of the people they govern and are almost never hereditary. Dictators also maintain exclusive control over the government.

Most dictatorships are established through violence, force, and sometimes political trickery. Joseph Stalin used these methods while serving as general secretary of the Communist Party in the Soviet Union, and he became dictator of the country in 1929. Dictators must continue to use force to maintain their power. Thus, most dictators outlaw or limit freedom of speech, assembly, and the press. Many dictators also forbid elections entirely. Many others change the votes or force people to vote for candidates chosen by the government. In spite of denying their citizens numerous basic freedoms, however, many dictatorships call themselves "people's republics" or "people's democracies."

Some dictatorships develop after a country has been conquered by a foreign power. The Soviet Union controlled much of Eastern Europe following World War II (1939-1945), and Stalin established Communist dictatorships in Poland, Czechoslovakia, and other nations in that region. A dictatorship may also take over a democratic nation during a period of crisis. The crisis may divide the government and limit its ability to maintain domestic order, security, and prosperity. Dictators who came to power under such circumstances included Benito Mussolini of Italy in 1922, Adolf Hitler of Germany in 1933, Francisco Franco of Spain in 1939, and Augusto Pinochet of Chile in 1973.

See also **Autocracy; Government.**

**Dictionary** is a book that contains a selected list of words arranged in alphabetical order. It explains their meanings and gives information about them. In a dictionary, a person can look up a word quickly, discover what it means, and learn how it is pronounced. Most modern dictionaries describe the facts of a language as educated speakers and writers use it. They are called *descriptive dictionaries* because a dictionary editor does not change the facts of a language. Many older dictionaries tried to prescribe rules, some of which did not agree with the way people commonly talked or wrote. These books are called *prescriptive dictionaries*.

### What dictionaries contain

Dictionaries give the meanings of many kinds of words. Most general dictionaries include (1) the ordinary words of everyday life, such as *bread*, *run*, and *with*; (2) literary words used in formal writing, such as *aggregation*, *despoil*, and *incontrovertible*; (3) technical words, such as *starboard*, *gene*, and *ratio*; (4) words used chiefly on informal occasions, such as *gab* and *wimp*; (5) words used in writing to give an old-fashioned flavour, such as *awearry* and *avaunt*; (6) words not used today but found in the writings of some authors, such as *plaister* for *plaster*; (7) words or phrases from other lan-

guages, such as *coup d'état* from French, *haiku* from Japanese, and *barrio* from Spanish; (8) *idioms* (groups of words with meanings different from their literal meanings), such as *split hairs* and *under the thumb of*; (9) abbreviations, such as *BBC*, *NSW*, and *km*; and (10) important proper names, such as *Buddha* and *Jupiter*.

No dictionary records all the words of any language. In fact, no one knows exactly how many English words there are. Besides ordinary words used in everyday speech, the English language includes thousands of geographical names. There are thousands of words that are no longer used. And there are hundreds of thousands of technical terms, including more than 750,000 names of insects alone. New words are coined for new scientific and technical discoveries, and slang words and special vocabularies constantly spring up. As nations draw closer together through trade and travel, satellite communication, and sharing of technology, languages tend to borrow more and more words from each other. That is why dictionary editors must be selective in the words they decide to include.

Most dictionaries tell us much more than just the meanings of words. Many list pronunciations, derivations, prefixes and suffixes, illustrative quotations, synonyms and antonyms, usage notes, and other information. The illustration with this article shows in detail what dictionaries tell us.

### Kinds of dictionaries

Dictionaries may be classified as *general dictionaries* and *specialized dictionaries*. A general dictionary contains information on everyday words such as *it* and *the*. But it also defines many technical terms such as *chromatography* and *columella*. A specialized dictionary omits most everyday terms, and limits itself to information on words used in a particular field, such as biology.

**General dictionaries** range in size from small pocket dictionaries to large multivolume or table dictionaries. The number of entries in a general dictionary depends on its purpose. Each dictionary is designed to answer the questions of a certain type of reader. A child in school, for example, would not want all the information given in a dictionary a university professor would use. For this reason, dictionary editors work hard to design their products to suit the needs of their intended audiences. They know that the usefulness of any dictionary depends on the education of the user and the kind of information the user wishes to find.

A general dictionary may be designed for use by primary-school students, secondary-school students, or college students. It may also be designed for use by the general reader, or even by the entire family. *The World Book Dictionary* is an example of a dictionary designed for family use.

The largest general dictionaries may contain over 400,000 entries. When a dictionary has this many entries, many obsolete and technical terms are included. Other general dictionaries may have from 15,000 entries to 200,000 entries.

**Specialized dictionaries** are designed to give more information in particular fields than general dictionaries can. A *gazetteer* (geographical dictionary) lists the names of cities, countries, islands, lakes, and other places. It gives the pronunciation of each name and a



**Word entries** begin in bold black type. Only proper nouns are capitalized. The first letter of the entry extends into the margin for easy location. This dictionary uses an asterisk to indicate that the entry is accompanied by an illustration.

**Illustrations** clarify the definitions. Labels show which meaning of the word is illustrated.

**Pronunciations** are given in phonetic symbols. This dictionary has a key to its phonetic symbols at the bottom of each right-hand page, with more detailed information at the front of the book.

**Parts of speech labels** show the word's grammatical use. Any word used as more than one part of speech is defined accordingly. The parts of speech are abbreviated, as in *adj.* for *adjective* and *n.* for *noun*. Verbs are shown as transitive (*v.t.*) or intransitive (*v.i.*).

**Phrases** that include the key word but have special meanings of their own are explained separately.

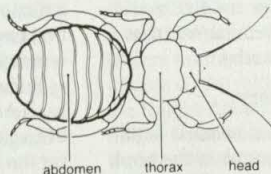
**Synonyms** that have the same or nearly the same meaning as the defined words appear immediately after the definition.

**Synonym studies** explain in detail the various shades of meaning of some synonyms. All these studies include examples.

**Usage notes** explain points of spelling or grammar and advise how to use the word in speaking or writing.

**\*abdomen** (ab'də mən, ab dō'-), *n.* **1a** the part of the body containing the stomach and the intestines; belly. In man and other mammals the abdomen is a large cavity between the chest (thorax) and the pelvis, and also contains the liver, pancreas, kidneys, and spleen. **b** a corresponding region in vertebrates below mammals. **2** the last of the three parts of the body of insects and many other arthropods, including spiders and crustaceans. [*< Latin abdōmen*]

**\*abdomen**  
definition 2



**Definitions** give the precise meanings of words. If a word has more than one meaning, the definitions are numbered. This dictionary lists the most common meanings first. Some dictionaries present definitions in historical order, with the earliest meanings first.

**Examples** point out how the word is used in phrases or sentences.

**Cross-references** show that the form consulted is less widely used than some other form, which has its own main entry.

**Other forms** of the word include the principal parts of verbs, unusual plural forms, and comparative forms for adjectives.

**Quotations** from well-known authors or publications illustrate the meaning of the word. The sources of quotations are identified.

**Usage labels**, such as *Slang*, *Informal*, *Archaic*, and *Obsolete*, indicate when and where the word is acceptable in current English usage. Each label is defined in a list at the front of the dictionary.

**Etymologies** tell what language or languages a word comes from, usually with its meaning in the original language. The symbol *<* means *comes from*.

**Foreign words and phrases** in common use in English have entries that give their pronunciation and translation, often with examples or illustrative quotations.

**abdominal** (ab dom'e nəl), *adj.* of the abdomen; in the abdomen; for the abdomen: *Bending the body exercises the abdominal muscles.* **SYN:** ventral, visceral. — **abdominally**, *adv.*

**abdominal brain**, = solar plexus.

**abdominous** (ab dom'e nəs), *adj.* = potbellied.

**abide**¹ (ə bīd'), *v.* **a** bode or abided, **a** biding.

— **v.t.** **1** to put up with; endure; tolerate: *A good housekeeper can't abide dust. She can't abide him.* **SYN:** bear, stand. **2** to await submissively; submit to; sustain: *He must abide his fatal doom (Joanna Baillie).* **3** to await defiantly; withstand: *He soon learned to abide... terrors which most of my bolder companions shrunk from encountering (Hugh Miller).* **4** Archaic, to wait for; await: *I will abide the coming of my lord (Tennyson).*

— **v.i.** **1** to stay; remain; wait: *Abide with me for a time. I'll call upon you straight: abide within (Shakespeare).* *He within his ships abode the while (William Cowper).* **2** to continue to live (in a place); reside; dwell: *No martin there in winter shall abide (John Dryden).* **3** to continue (in some state or action): *... ye shall abide in my love (John 15:10).* **4** to continue in existence; endure: *Thou hast established the earth, and it abideth (Psalms 119:90).* **SYN:** last. **5** Archaic, to be left. **6** Obsolete, to stay behind.

**abide by**, **a** to accept and follow out; be bound by: *Both teams will abide by the umpire's decision.* **b** to remain faithful to; stand firm by; be true to; fulfill: *Abide by your promise.*

**ability** (ə bil'ē tē), *n.*, *pl.* -ties. **1** the power to do or act: *the ability to think clearly.* *The old horse still has the ability to work.* **SYN:** capability, capacity. **2** skill: *Washington had great ability as a general.* **3** power to do some special thing; natural gift; talent: *Musical ability often shows itself early in life.* [*< Middle French habilité, learned borrowing from Latin habilitās aptness < habilis able*]

— **SYN.** **2, 3** Ability, talent mean special power to do or for doing something. Ability applies to a demonstrated physical or mental power to do a certain thing well: *She has developed unusual ability as a dancer.* Talent applies to an inborn capacity for doing a special thing: *a child with a remarkable talent for painting.*

► After ability the infinitive of a verb preceded by *to* is used, rather than the gerund preceded by *by of*: *A lawyer needs the ability to think clearly, not of thinking clearly.* The preposition used after ability and before a noun is *in*: *ability in music.*

**Abimelech** (ə bīm'ē lek), *n.* a son of Gideon who was set up as king of Israel by the people of Shechem (in the Bible, Judges 9).

**ab init.**, *ab initio*.

**ab initio** (ab' i nish'ē ō), *Latin*, from the beginning: *The decree was not a nullity in the sense of being void ab initio (London Times).*



brief description. A *biographical dictionary* lists and gives the pronunciation of the names of important people. Each entry includes birth and death dates, nationality, and why the person is remembered. A *thesaurus* contains lists of synonyms and antonyms. Other specialized dictionaries are devoted to usage; idioms; pronunciations; slang; spelling; new words and meanings; and various aspects of science and technology. Research or scholarly dictionaries may cover the vocabulary of earlier periods of a language, such as Old English or Late Latin. Some are also devoted to various dialects, such as Scottish or South African English. There are dictionaries of all the major languages. *Bilingual dictionaries* translate the words of one language into another.

### How to use a dictionary

Before using a dictionary, one should become familiar with the methods, principles, and scope of the book because various dictionaries are arranged in different ways. Many dictionaries have all entries arranged in a single alphabetical list. Others arrange abbreviations, geographical and biographical names, and foreign words and phrases in separate lists, usually at the end of the book. All good dictionaries today have introductory sections that explain what the book contains and how it is arranged.

The first thing a dictionary entry shows is how to spell a word and perhaps how to divide it into syllables. Accent marks and symbols that are explained in the book tell the reader how to pronounce the word. Many dictionaries also tell what part of speech the word is. For example, they list *boy* as a *noun*, and *speak* as a *verb*.

Definitions of the word usually follow. Some dictionaries list the most commonly used meaning of the word first. Others arrange the meanings historically, so that the first meaning listed is the one that occurred first in the language. Some dictionaries also use the word in a sentence or phrase to help define it. Sometimes pictures or drawings are added to tell more about the entry.

After the definitions, many dictionaries include a list of *synonyms*, or words with about the same meaning as the words being defined. Other information is often included about *etymology* (the history or origin of a word). Many dictionaries also have usage labels, such as *Slang* and *Dialect*; subject labels, such as *Biology* or *Electronics*; and regional labels, such as *British* or *U.S.* In addition, usage notes explain important points about the way a word is commonly used.

### History

The word *dictionary* comes from the medieval Latin word *dictionarium*, which in turn came from the Latin *dictio*, meaning *word* or *saying*. The ancient Greeks and Romans were the first to produce these works. But most Greek and Latin dictionaries were either lists of rare and difficult words or specialized lists of words.

During the Middle Ages, scholars made much use of Latin dictionaries which explained hard Latin words in easier Latin. Toward the end of the Middle Ages, as Latin began to lose ground to English, French, German, and other national languages of Europe, scholars began to rely on *glossaries* to understand Latin manuscripts. The glossaries usually gave the meanings of hard Latin words in the words of the national language. As these

languages became accepted in each country, people needed new dictionaries to explain the hard words of their own language in terms of simpler words in the same language.

**Early English dictionaries.** In 1604, Robert Cawdrey, a schoolmaster, prepared the first English dictionary. Called *The Table Alphabetical of Hard Words*, it defined about 3,000 English words that had been taken from other languages. Larger dictionaries that offered more information about the words they contained were produced in the 1600's. In 1721, Nathan Bailey published a dictionary containing about 60,000 words. This was the first English dictionary that tried to include most English words instead of hard words only.

In the early 1700's, Jonathan Swift, Alexander Pope, Joseph Addison, Samuel Johnson, and other literary men of England wanted to prepare a dictionary that would set the standard for good usage in English. French and Italian scholars had already published such prescriptive dictionaries in their languages, and this success influenced the literary men of England.

Samuel Johnson undertook the task of preparing an English dictionary. He spent several years selecting quotations from the best writers to illustrate the meanings of words. He came to the conclusion that language could not be "fixed" or prescribed, only described to the best of one's ability. Johnson finally published his great work, *A Dictionary of the English Language*, in 1755. With John Walker's *Critical and Pronouncing Dictionary and Expositor of the English Language* (1791), it served as the standard for information about English words until the mid-1800's.

In 1806, Noah Webster published a small school dictionary in the United States. Webster wanted to set up an American standard of good usage to compare with the British standard set by Johnson and Walker. In his dictionary, Webster simplified many older spellings, such as *music* for *musick*. He also adopted such spellings as *color* and *odor*. These are now standard American spellings for words that usually appear in Britain as *colour* and *odour*. In 1828, Webster published a dictionary containing 70,000 entries. Since then, Webster's dictionaries have been frequently revised and are widely used today.

**Modern dictionaries.** The period of national dictionaries gave way to scholarly dictionaries in the mid-1800's. In Germany, the brothers Jakob and Wilhelm Grimm began work on a historical dictionary of the German language. In France, Emile Littré compiled a dictionary of modern French. In England, John Ogilvie edited a dictionary that later served as the basis of *The Century Dictionary*. Various English dictionaries produced today trace their development back to *The Century Dictionary*.

Probably the greatest scholarly dictionary to appear in any language is *A New English Dictionary on Historical Principles*. It appeared in parts from 1884 to 1928 and has almost 415,000 entries. In 1933, it was published in 12 volumes, with a one-volume supplement, as the *Oxford English Dictionary (O.E.D.)*. This dictionary gives a historical record of each meaning of a word and tells the date the word first occurred in written English. It also lists other dates that show how the word has been used through the years. No other dictionary in any lan-



guage approaches the *O.E.D.* in wealth and authority of historical detail. A four-volume supplement was published from 1972 to 1985 and a full revised edition in 20 volumes appeared in 1989. The historical method used to compile the *O.E.D.* was also used in making other national dictionaries, such as *A Dictionary of Canadianisms* (1967) and the *Australian National Dictionary* (1988).

*Webster's Third New International Dictionary*, with about 450,000 entries, is the most complete modern American dictionary of the English language. *The World Book Dictionary*, which is a Thorndike-Barnhart work of more than 225,000 entries, is designed for family use. It was the first dictionary especially designed to be used with a specific encyclopedia. Many dictionary publishers offer basic, intermediate, and secondary school dictionaries that contain from as few as 18,000 to as many as 100,000 entries. Some publishers have also adapted dictionaries for computer use.

**Related articles.** See the separate articles in *World Book* on each letter of the alphabet. See also:

Abbreviation	Language	Synonym
Antonym	Linguistics	Syntax
Barnhart, Clarence L.	Parts of speech	Thorndike, Edward Lee
Etymology	Pronunciation	Webster, Noah
Grammar	Punctuation	
Johnson, Samuel	Spelling	

**Diderot, Denis** (1713-1784), was a major French philosopher of an intellectual movement called the Age of Reason. His work extended beyond philosophy and included writings in fiction, drama, and art and literary criticism. Diderot was also a satirist and a brilliant conversationalist. He spent much of his life compiling, editing, and writing the French *Encyclopédie*, a reference work that reflected revolutionary political views and antireligious sentiment. Diderot's major philosophical works are *Thoughts on the Interpretation of Nature* (1754) and *d'Alembert's Dream* (1769). Today, Diderot is increasingly appreciated for his major literary writings, especially the novels *The Nun* (1760) and *Jacques the Fatalist* (1773) and the satirical dialogue *Rameau's Nephew* (written 1762-1764).

Diderot strongly supported experimental methods in philosophy and science. He believed that nature was in a state of constant change and no permanently adequate interpretation of it was possible. Diderot was also a philosophical materialist, believing that thought developed from the movements and changes of matter. His views on this subject were vague, as were his religious opinions. At one time, he was an atheist. At another time, Diderot was a deist, believing that God existed independently of the world and had no interest in it. But he later suggested that all of nature was God. Diderot was born in Langres, near Chaumont.

See also **Age of Reason**; **Encyclopaedia** (An age of experiment); **Drama** (European drama [France]).

**Didgeridoo** is a musical instrument that the Aborigines of northern Australia play in their religious ceremonies. Most didgeridoos are about 1.5 metres long, but some are 3 to 4.5 metres long. They are made from straight, hollowed-out pieces of wood, usually eaten up the centre by termites. The Aborigines blow into these wooden pipes to produce a rhythmic, booming sound. In northwestern Australia, Aborigines place the end of the instrument in a hollow in the ground to add resonance. See also **Australian Aborigines**.

**Didion, Joan** (1934- ), is an American essayist and novelist. She was born in Sacramento, California, and often has used California's culture and geography and the lives of its residents as topics and symbols especially in her earlier writings. Didion writes in a spare and intense style that conveys a lack of roots and a sense of social disintegration.



Joan Didion

In the title essay of her collection *Slouching Towards Bethlehem* (1968), Didion examines the drug culture of the mid-1960's in the Haight-Ashbury section of San Francisco. Her collection *The White Album* (1979) similarly explores such California phenomena as exotic religious groups, Los Angeles freeways, and *bike movies* (films about motorcycle gangs). Didion's novels include *Run River* (1963), *Play It As It Lays* (1970), *A Book of Common Prayer* (1977), and *Democracy* (1984). Didion concentrated on political subjects in such nonfiction books as *Salvador* (1983).

**Dido**, also called Elissa, was the legendary founder and queen of Carthage. She was the daughter of King Belus of Tyre, and the wife of Sychaeus, or Acerbas. She fled to Africa with many devoted followers after her brother, Pygmalion, murdered her husband. There she was offered as much land as might be surrounded by a bull's hide. She cut a hide into thin strips, pieced them together, and laid them out to surround a large area. This area became the site of Carthage (see **Carthage**).

In the original legend, Dido committed suicide to escape an African prince who wished to marry her. But in the Roman epic poem the *Aeneid*, Dido killed herself after the Trojan hero Aeneas deserted her. Aeneas later saw Dido when he visited the Underworld, but she had been happily reunited with Sychaeus and would not look at Aeneas (see **Aeneid**).

**Didrikson, Babe.** See **Zaharias, Babe Didrikson**.

**Didymus.** See **Thomas, Saint**.

**Die and diemaking.** A die is a precision tool used to shape or cut metals or other materials. Diemaking is the process of producing dies. Diemakers, who are usually called *tool and diemakers*, rank among the most highly skilled industrial workers. The diemaker's product ranges from small diamond dies, used to draw metal into fine wire, to huge metal dies that form car parts.

Materials used for making dies include alloy steels, rubber, plastics, and certain combinations of materials. The materials are shaped by basic machine tools or by newer methods, including the use of electricity (see **Machine tool** [Advanced machine tool operations]). After shaping, most dies are *heat treated* (carefully heated and cooled) to make them more resistant to wear.

When in use, certain dies must be lubricated. Common lubricants include oils and greases, soap solutions, and various chemical compounds. Dies used at high temperatures require such lubricants as graphite in oil or water, or molybdenum disulphide.

Dies are used in several industrial processes, includ-



ing die casting, drawing, extrusion, forging, and stamping. Some of these processes use pairs of dies, one called a *male die*, or *punch*, and the other a *female die*.

In die casting, metals are melted in a machine that forces the liquid metal into steel dies. These dies replace the moulds used in other casting. The metal hardens into the design of the die and comes out solid. See **Cast and casting**.

In drawing and extrusion, a hot or cold solid material, usually metal, is forced through an opening in a die (see **Extrusion**).

In forging, metal is often heated and put into two dies. The dies are pressed together and shape the metal. See **Forging**.

In stamping, a machine uses dies to stamp sheets, plates, or strips of metal or other materials, including plastics. Some stamping dies punch a hole in metal or cut it to a desired shape. Others form and shape the metal. Still other stamping dies do both jobs.

See also **Toolmaking**.

**Diefenbaker, John George** (1895-1979), served as prime minister of Canada from 1957 to 1963. Diefenbaker was born in Neustadt, Ontario. He studied law at the University of Saskatchewan. In 1940, he was elected to the Canadian House of Commons, and in 1956 became leader of the Progressive Conservative party. Diefenbaker became prime minister when his party won the 1957 election after 22 years of Liberal rule. In the 1958 election, Diefenbaker's party won by an overwhelming majority.

As prime minister, Diefenbaker carried out a programme of social reform. A controversy arose over his refusal to accept atomic warheads for defence missiles supplied by the United States. In the 1963 election, the Progressive Conservatives were defeated by the Liberals. Diefenbaker led the opposition in Parliament until his resignation in 1967.

**Diego Garcia** is an island in the Indian Ocean. It is part of the Chagos Archipelago, an island group. The United States maintains a naval base on Diego Garcia that serves as a communications centre and a refuelling stop for ships and aeroplanes.

Diego Garcia is a U-shaped coral island called an *atoll*. It is about 25 kilometres long, and about 10 kilometres wide at its widest point.

Diego Garcia came under the United Kingdom's control in 1814, and until 1965 was administered as a dependency of the colony of Mauritius. In 1965, Diego Garcia became part of a newly formed dependency called the British Indian Ocean Territory. For the location of this dependency, see **World** (political map).

In 1966, the United Kingdom agreed to allow the construction of the U.S. naval base on Diego Garcia. The base was built during the 1970's. By 1972, UK authorities

had moved all of the island's inhabitants to Mauritius. Today, about 1,300 American naval workers and 25 UK naval representatives live on Diego Garcia. Since 1982, Mauritius has claimed the Chagos Archipelago, including Diego Garcia.

See also **Rapid Deployment Force**.

**Diem, Ngo Dinh**. See **Ngo Dinh Diem**.

**Diemaking**. See **Die and diemaking**.

**Dien Bien Phu, Battle of**, was fought between Vietnamese Communists, called *Vietminh*, and France in 1954. It was the decisive battle of the Indochina War (1946-1954). The French were defeated, and they gave up their colonies in Indochina.

In November 1953, France began building an army base around the village of Dien Bien Phu (also called Dien Bien), in what is now northwestern Vietnam. For the village's location, see **Vietnam** (map). The base was intended to disrupt Vietminh army movements. On March 13, 1954, about 50,000 Vietminh soldiers began attacking the French force of more than 10,000 troops at the base. They quickly destroyed the base's airfield, leaving the French without adequate supplies. The outnumbered French resisted the Vietminh attack for 56 days, but were forced to surrender on May 7, 1954. The fighting ended early the next day.

**Diesel, Rudolf** (1858-1913), a German mechanical engineer, developed an internal-combustion machine that used oil as fuel. Because of its simplicity of design and the economy of its fuel, the diesel engine is frequently preferred to the petrol engine. It has greatly increased the efficiency of industry and transportation. See **Diesel engine**.

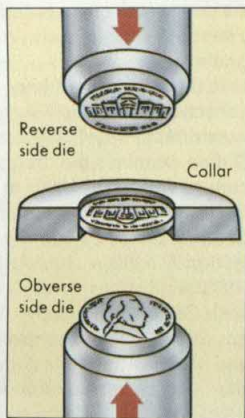
Diesel was born in Paris of German parents, and received his technical education in Munich. He became interested in designing an engine more efficient than steam and gas engines. He based his work on the theory of heat engines and on the designs of other engineers. He patented his design in 1892, and had completed and operated the first successful diesel engine by 1897. He also founded a factory to make diesel engines. In 1913, Diesel mysteriously disappeared from a German ship bound for London.

See also **Ship** (Increasing power and speed).

**Diesel engine** is a type of internal-combustion engine used chiefly for heavy-duty work. Diesel engines drive huge freight trucks, large buses, tractors, and heavy road-building equipment. They are also used to power submarines and ships, and the generators of electric-power stations in small cities. Some motor cars are powered by diesel engines.

**How a diesel engine works**. There are two main types of internal-combustion engines. One type, found in most motor cars, is called a *spark-ignition* engine. It uses electricity and spark plugs to ignite the fuel in the engine's cylinders (see **Petrol engine**). The other type, the diesel engine, is a *compression-ignition* engine. When air confined in a cylinder is suddenly compressed, the temperature of the air rises. In a diesel engine, each piston compresses air in a cylinder. Fuel is injected and forms an explosive mixture, which ignites spontaneously under pressure.

Diesel engines burn fuel oils, which require less refining and are cheaper than higher-grade fuels such as petrol. During the combustion process, the stored



**Coin-stamping dies** stamp both sides of a coin in one operation. A collar holds the coin metal, called a *blank*, as it is fed into a stamping press.



chemical energy in the fuel is converted to *thermal*, or heat, energy. The temperature in each cylinder rises as high as 2,480° C and creates pressures of about 100 kilograms per square centimetre. The pressure pushes against the tops of the pistons, forcing them to the other end of their cylinders. The pistons are connected by a rod or other suitable connecting mechanism to a crankshaft which they turn. In this way, a diesel engine supplies rotary power to drive vehicles and other kinds of machines.

In order for the compressed air inside the cylinders to ignite the fuel, it must have a certain temperature. The degree to which the temperature of the air rises depends on the amount of work done by the piston in compressing it. This work is measured in terms of the ratio between the volume of uncompressed air and the volume of the air after it is compressed. The compression ratio necessary to ignite the fuel depends on the size of the engine's cylinders. In large cylinders, the compression ratio is about 13 to 1. For small cylinders, it may be as high as 20 to 1. The average is 14.5 to 1.

Near the end of the piston's compression stroke, the fuel is injected into a cylinder. In order to have the fuel and air mix well, the fuel is injected under high pressure as a spray. Combustion usually starts just before the piston ends its compression stroke. The power of diesel engines can be increased by *supercharging*. This is the technique of forcing air under pressure into the cylinders. See **Fuel injection**.

Diesel engines have a high *thermal efficiency*, or ability to convert the stored chemical energy in the fuel into *mechanical energy*, or work. They burn a fuel that is cheaper than petrol, and they can perform heavy work under highly overloaded conditions. This is why they are favoured for heavy-duty work.

**Kinds of diesel engines.** There are two main types of diesel engines. They differ according to the number of piston strokes required to complete a cycle of air compression, exhaust, and intake of fresh air. A *stroke* is an up or down movement of a piston. These engines are

(1) the four-stroke cycle engine and (2) the two-stroke cycle engine.

In a *four-stroke engine*, each piston moves down, up, down, and up to complete a cycle. The first downstroke draws air into the cylinder. The first upstroke compresses the air. The second downstroke is the power stroke. The second upstroke exhausts the gases produced by combustion. A four-stroke engine requires exhaust and air-intake valves.

In a *two-stroke engine*, the exhaust and intake of fresh air occur through openings in the cylinder near the end of the downstroke, or power stroke. The one upstroke is the compression stroke. A two-stroke engine does not need valves. These engines have twice as many power strokes per cycle as four-stroke engines, and are used where high power is needed in a small engine.

**History.** The diesel engine is named after Rudolf Diesel, the German engineer who invented it. Diesel patented his design for the engine in 1892 and built his first engine in 1893. The engine exploded and almost killed him, but it proved that fuel could be ignited without a spark. He operated his first successful engine in 1897. Later, Sir Dugald Clerk of the United Kingdom developed the two-stroke diesel.

See also **Car** (History of the car); **Diesel, Rudolf**; **Engine analyser**; **Locomotive**; **Starter**.

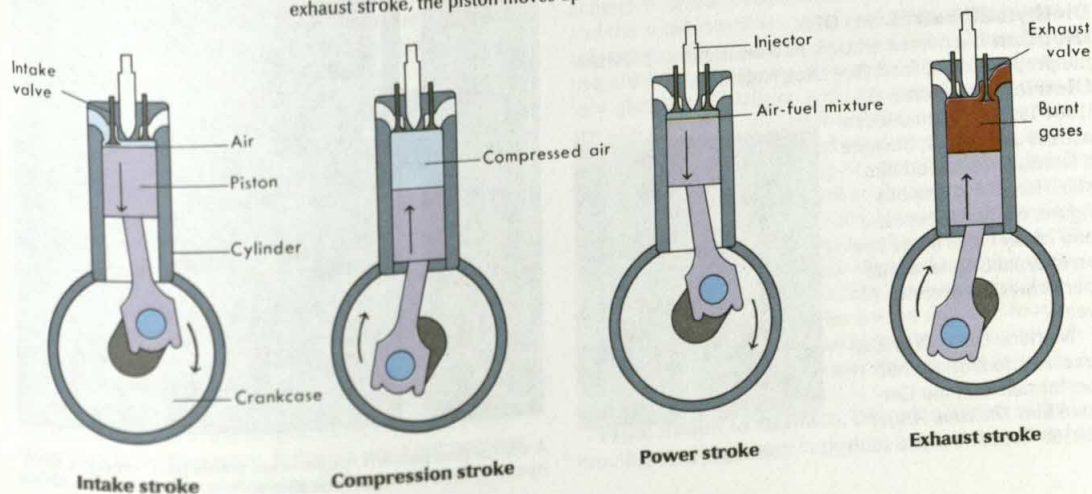
**Diet.** See **Japan** (Government).

**Diet** is the food and drink that a person takes regularly day after day. The word *diet* also refers to the amounts or kinds of food needed under special circumstances, such as losing or gaining weight. Dietary needs vary according to age, weight, condition of health, climate, and amount of activity. *Dietetics* is the science of feeding individuals or groups. The money available and health and nutritional needs affect the type of feeding prescribed.

**Normal diet**, or *balanced diet*, contains all the food elements needed to keep healthy. A person needs *minerals*, *proteins*, *vitamins*, and certain *fats* to build and maintain tissues and to regulate body functions. *Proteins*, *fats*, and *carbohydrates* are used to provide en-

### How a four-cycle diesel engine works

A cycle begins with the intake stroke when the piston moves down and draws air into the cylinder. During the compression stroke, the air temperature rises to about 480° C. When fuel is injected into the cylinder, it mixes with the hot air and burns explosively. Gases produced by this combustion push the piston down for the power stroke. During the exhaust stroke, the piston moves up and forces the burned gases out of the cylinder.





ergy and heat. A diet that lacks any needed food element may cause certain *deficiency diseases*. For example, lack of vitamin C causes scurvy, and lack of iron, *folate* (a B-vitamin), or vitamin B<sub>12</sub> causes anaemia (see *Anaemia*; *Scurvy*).

**Diets for losing or gaining weight.** Both the energy value of food and the energy spent in daily activity are measured in units of heat called *kilocalories*. These measurements are also referred to as *food calories*, or simply *calories* (see *Calorie*). Diets for gaining or losing weight are based on the amount of calories taken into the body in food and the amount of calories used up in activity. If people take in more calories than they use up, they will gain weight. They will lose weight if they take in fewer calories than they use up. A diet aimed toward losing or gaining weight should include all the food elements. People should seek the advice of a doctor before beginning such a diet.

**Special diets** may be prescribed for people suffering from certain diseases. For example, the healthy body needs sugar, but a person with diabetes must limit the use of sugar. Doctors may prescribe low-salt diets for patients with certain heart or kidney diseases.

Some people suffer allergic or skin reactions from certain food products, such as milk, tomatoes, strawberries, wheat, potatoes, eggs, fish, nuts, chocolate, or pork. These people should consult a doctor.

Certain groups of people, such as young children or older people, have special dietary needs. Because children grow rapidly, they need food not only to replace worn-out tissues and provide energy, but also to build new tissue. A well-balanced diet for a child or an adult should include milk and milk products; eggs, lean meat, poultry, fish; or nuts, seeds, and *legumes*, such as peas and soybeans; fruit and vegetables; and cereals or bread products. Older people need as many nutrients as children and young adults. But if their activity is reduced, they need fewer calories. Expectant or nursing mothers and babies also need special diets (see *Baby* [The expectant mother; Feeding procedures]).

**Related articles** in *World Book* include:

Allergy	Fat	Metabolism
Calorie	Food	Nutrition
Carbohydrate	Fruit (introduction)	Protein
Cooking	Health	Vitamin
Digestive system	Lipid	Weight control

**Diethylstilbestrol.** See *DES*.

**Dietitian** is a person who plans menus and supervises the preparation of food. See *Diet*; *Nutrition*.

**Dietrich, Marlene**

(1904-1992), a German-born actress and singer, became a famous Hollywood film star. Her charm, famous figure, expressive eyes, and husky voice made her an international favourite performer for over 40 years.

Marlene Dietrich first attracted attention for her performance in the German film *The Blue Angel* (1930). Then she made such



Marlene Dietrich

American films as *Morocco* (1930), *Shanghai Express* (1932), *The Garden of Allah* (1936), and *Destry Rides Again* (1939). Since World War II her films included *A Foreign Affair* (1948), *Witness for the Prosecution* (1958), and *Judgment at Nuremberg* (1961).

Marlene Dietrich was born Maria Magdalene Dietrich in Berlin.

**Differential.** See *Car* (The power train).

**Diffraction** is the spreading out of waves—water, sound, light, or any other kind—as they pass by the edge of an obstacle or through an opening. Diffraction explains why water waves spread in all directions after passing through a narrow channel in a breakwater. It also explains why sound can be heard around a corner when no straight path exists from the source of the sound to the ear.

Diffraction of light differs from diffraction of sound because diffraction is most evident when the obstacle is about the same size as the wavelength diffracted. The sound waves we hear have wavelengths of about a metre and are diffracted by ordinary objects. But visible light waves have wavelengths of less than 0.00007 centimetre. Thus, light waves can be diffracted noticeably only by extremely small objects.

**How diffraction occurs.** Diffraction takes place among all waves at all times. To understand why it becomes noticeable only when the obstacle is about the size of the diffracted wavelength, one must understand both diffraction and *interference*.

Christiaan Huygens, a Dutch scientist, developed the principle that explains why diffraction occurs. This principle states that each point on the surface of a wave is the source of small waves. These wavelets move outward in all directions. To find the total wave reaching an area, all the wavelets that strike the area must be considered. If the crests of two wavelets reach a point at the same time, they reinforce each other. This condition is called *constructive interference*, and the resulting wave



A diffraction pattern results when waves pass through a small opening, as in the water tank above.



is large. If the crest of one wave reaches a point at the same time as the low point of another, the two waves cancel each other. This condition is called *destructive interference*, and the resulting wave is small or nonexistent. See *Interference*.

A beam of light moves in a straight line because effects of diffraction outside the beam are cancelled by destructive interference. The wavelets at the edge of the beam spread, but most of the light travels in a straight line with the beam. When light travels through a tiny opening, interference occurs only among the wavelets coming from the opening. These wavelets produce a diffraction pattern because most of the destructive interference has been eliminated.

Diffraction of light from a tiny source can likewise be observed if some of the light—and thus its interference—is removed. A disc placed in the path of such a source blocks out the wavelets that originate behind the disc. At points beyond the disc, these eliminated wavelets are missing not only in the shadow of the disc but also outside of the shadow, where they would have interfered constructively. The shadow pattern on a screen beyond the disc consists of a series of rings, alternately light and dark, in and surrounding the shadow area. A bright spot occurs at the centre of the shadow because at that point all waves interfere constructively. They do so because they have all travelled the same distance from the edge of the disc.

**Uses of diffraction.** The occurrence of diffraction has been used as a test of whether various things are waves. For example, diffraction of X rays by crystals convinced scientists that X rays are waves.

The pattern of X-ray diffraction depends on the type and distribution of atoms in the diffracting substance. This fact has been used to study the structure of crystals by X-ray diffraction and to discover the structure of proteins and nucleic acids.

A *diffraction grating* is a glass plate with lines ruled on it at small, equal intervals. Light can pass only between the lines, and the slits are about as far apart as a wavelength of light. If a parallel beam of white light strikes the grating, a pattern of light of various colours appears on a screen beyond the grating. The colours appear because white light consists of different colours. These colours have different wavelengths, and the longer wavelengths are diffracted at greater angles. Scientists can identify a substance by the pattern of colours it produces through a diffraction grating.

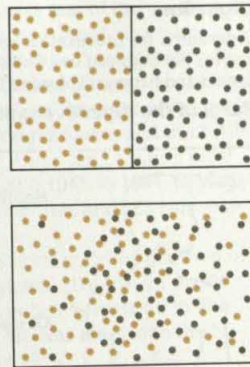
See also *Light* (How light behaves); *Molecule*; *Sound* (Diffraction); *Spectrometer*; *Waves*.

**Diffusion**, in chemistry, is the mixing of the atoms or molecules of one substance with those of another. It is caused by the natural movements of atoms and molecules. It differs from the mixing caused by stirring or shaking or the blowing of wind.

Diffusion occurs readily in gases and liquids because of the constant and random motion of their atoms and molecules. The process takes place more rapidly in gases than in liquids. Molecules of gases are farther apart and collide less frequently than those of liquids—and collisions among molecules hinder diffusion. In solids, the molecules are arranged in rigid patterns and move very little. Therefore, diffusion does not occur in solids except under special conditions.

## How diffusion occurs

The diagrams on the right show how diffusion occurs in gases. The molecules of two different gases in a container are separated by a divider, *top*. After the divider is removed, the molecules begin to mix together because of their constant movement, *bottom*. As the molecules move at random, some of them bump into one another and slow down the mixing process.



Diffusion can be demonstrated by adding ink to a glass of water. Each molecule of ink has its own constant and random motion. The motion of the ink molecules causes them to spread through the water. The water molecules also move about and become mixed with the ink molecules. After being mixed completely, the molecules of ink and water each continue to move individually. But as a result of diffusion, the colour of the mixture becomes the colour of the ink.

Many common occurrences involve diffusion. For example, water boiling in an uncovered pot produces steam that disappears. The disappearance results from the diffusion of steam molecules with air molecules. Odours from flowers, food, perfume, and other sources are produced by the diffusion of special gaseous odour molecules with molecules of air.

**Digestion.** See *Digestive system*.

**Digestive system** is the group of organs that break down food into smaller particles, or molecules, for use in the human body. This breakdown makes it possible for the smaller digested particles to pass through the intestinal wall into the bloodstream. The particles are then distributed to nourish all parts of the body.

The digestive system consists primarily of the *alimentary canal*, a tube that extends from the mouth to the rectum. As food moves through this canal, it is ground and mixed with various digestive juices. Most of these juices contain *digestive enzymes*, chemicals that speed up reactions involved in the breakdown of food. The stomach and the small intestines, which are parts of the alimentary canal, each produce a digestive juice. Other digestive juices empty into the alimentary canal from the salivary glands, gall bladder, and pancreas. These organs are also part of the digestive system.

The fats, proteins, and carbohydrates (starches and sugars) in foods are made up of very complex molecules and must be digested, or broken down. When digestion is completed, starches and complex sugars are broken down into simple sugars, fats are digested to fatty acids and glycerol, and proteins are digested to amino acids and peptides. Simple sugars, fatty acids and glycerol, and amino acids and peptides are the digested foods that can be absorbed into the bloodstream. Foods such as vitamins, minerals, and water do not need to be digested.

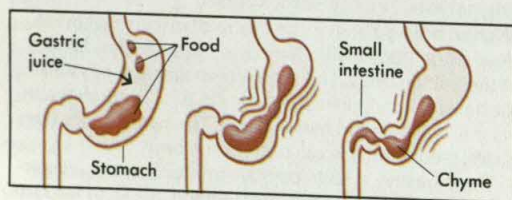
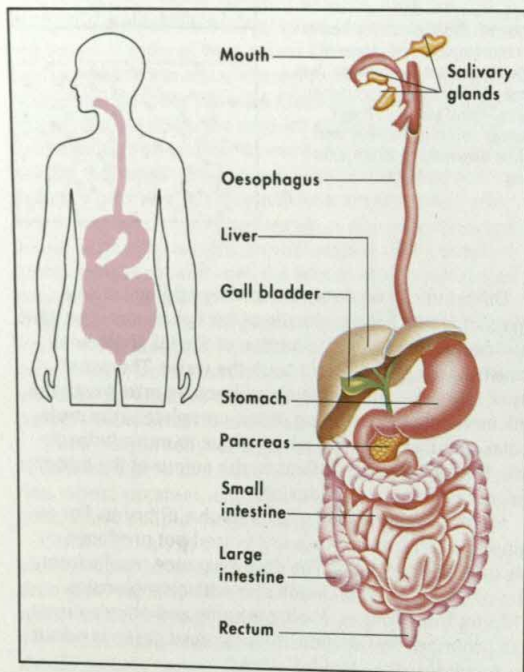
**From mouth to stomach.** Digestion begins in the mouth. Chewing is very important to good digestion for



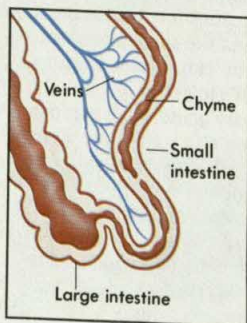
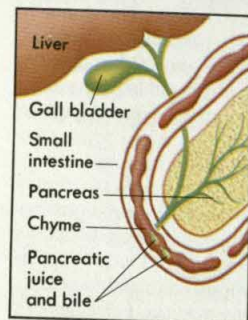
## Digestion

Digestion is the process that breaks food down into simple substances the body can use. The digestive system includes all the organs and tissues involved in this process.

### Parts of the digestive system



The stomach churns food and adds gastric juice, which breaks down proteins. Food exits the stomach as *chyme*, a thick liquid.



**Bile and pancreatic juice** act on the chyme in the upper small intestine. Pancreatic juice digests proteins, fats, and sugars and starches. Bile helps break down fats.

**Digested foods** are absorbed into the bloodstream from the small intestine. The indigestible remains pass into the large intestine and are eliminated from the body.

two reasons. When chewed food is ground into fine particles, the digestive juices can react more easily. As the food is chewed, it is moistened and mixed with saliva, which contains the enzyme *ptyalin*. Ptyalin changes some of the starches in the food to sugar.

After the food is swallowed, it passes through the oesophagus into the stomach. In the stomach it is thoroughly mixed with a digestive juice by a vigorous, to-and-fro churning motion. This motion is caused by contractions of strong muscles in the stomach walls.

The digestive juice in the stomach is called *gastric juice*. It contains hydrochloric acid and the enzyme *pepsin*. This juice begins the digestion of protein foods such as meat, eggs, and milk. Starches, sugars, and fats are not digested by the gastric juice. After a meal, some food remains in the stomach for two to five hours. But liquids and small particles begin to empty almost immediately. Food that has been churned, partly digested, and changed to a thick liquid is called *chyme*. Chyme passes from the stomach into the small intestine.

In the small intestine, the digestive process is completed on the partly digested food by pancreatic juice, intestinal juice, and bile. The pancreatic juice is produced by the pancreas and pours into the small intestine through a tube, or duct. The pancreatic juice contains the enzymes *trypsin*, *amylase*, and *lipase*. Trypsin breaks down the partly digested proteins, amylase changes starch into simple sugars, and lipase splits fats into fatty acids and glycerol. The intestinal juice is produced by the walls of the small intestine. It has milder digestive effects than the pancreatic juice, but carries out similar digestion. Bile is produced in the liver, stored in the gall bladder, and flows into the small intestine through the bile duct. Bile contains chemicals that help break down and absorb fats.

When the food is completely digested, it is absorbed by tiny blood and lymph vessels in the walls of the small intestine. It is then carried into the circulation for nourishment of the body.

**Related articles in World Book include:**

Alimentary canal	Cellulose	Intestine	Pancreas
Amino acid	Dyspepsia	Liver	Pepsin
Assimilation	Enzyme	Lymphatic system	Starch
Bile	Fat	Mastication	Stomach
Carbohydrate	Gland	Oesophagus	Sugar
	Indigestion		Teeth

**Digit.** See Arabic numerals; Decimal system.

**Digital computer.** See Computer.

**Digitalis** is a powerful drug made from the dried leaves of the purple foxglove, a common woodland and garden plant. It takes its name from the scientific name of the foxglove (see *Foxglove*). In 1785, a British doctor, William Withering, introduced it for the treatment of certain heart diseases. Doctors use digitalis when the action of the heart muscles is too weak to force blood out of the heart normally. They also use it to make the heart beat more regularly. It can be given as a powder, in tablets, as a liquid, or in a solution called a *tincture*. Digitalis is very powerful and should be taken only under a doctor's direction.

**Digraph.** See Codes and ciphers (Cryptanalysis).

**Dik-dik** is one of the smallest antelopes. Dik-diks live in dense wooded areas. Four species live in eastern Africa and one species in southwestern Africa. The tallest



dik-diks are about 39 centimetres high at the shoulder. Females are larger than males but have no horns.

Dik-diks are delicate, slender animals with tiny hoofs, short tails, and long hairy muzzles. They live alone or in groups of two or three. Dik-diks warn each other of danger with high-pitched whistles.

**Scientific classification.** The dik-dik belongs to the bovid family, Bovidae. It is genus *Madoqua*.

See also **Antelope** (with picture).

**Dike.** See **Irrigation** (Surface irrigation; picture: Flood irrigation); **Netherlands** (introduction; pictures).

**Dill** is a plant used in making pickles and as a flavouring in other foods, including fish, sour cream, and vinegar. Dill is widely grown. Both the seeds, and the feathery leaves are used for cooking. In addition, a flavouring oil is distilled from the plant.

**Scientific classification.** Dill is a member of the parsley family, Umbelliferae (Apiaceae). It is classified as *Anethum graveolens*.



Dill

### Dillinger, John Herbert

(1903-1934), was one of the most notorious criminals in United States history. In 1933 and 1934, he and his gangs attracted national headlines for a series of Midwestern bank robberies and narrow escapes from the law.

Dillinger was born in Indianapolis, Indiana. He twice escaped from prison, once while facing charges of killing a policeman. By mid-1934, he had been involved in at least 10 bank robberies in Indiana, Ohio, Wisconsin, and South Dakota.

Dillinger was hiding in Chicago when he was betrayed by Anna Sage, an acquaintance, on July 22, 1934. Sage told federal agents she would be wearing a red dress when she and a girlfriend accompanied Dillinger to the Biograph theatre that night to see the Clark Gable crime movie *Manhattan Melodrama*. Federal agents fatally shot Dillinger as he left the theatre, and Sage became famous as the "woman in red."

**Dillon** is the family name of three prominent Irish politicians.

**John Blake Dillon** (1816-1866) was one of the founders of the Young Ireland movement. He was also one of the founders of the *Nation* newspaper. Dillon escaped to the United States in 1848 after the rising of the Young Irelanders failed. After seven years, Dillon returned to Ireland. He was a member of Parliament for Tipperary in 1865 and 1866. He was born at Ballaghaderreen, Mayo.

**John Dillon** (1851-1927) was the son of John Blake Dillon. He became prominent in the Irish agrarian movement in the late 1800's. He was one of the chief supporters of Charles Stewart Parnell, and a member of the Irish Party in the British House of Commons. He advocated measures designed to deal with landlords who charged unfair rent. He was born in New York City and studied at the Catholic University in Dublin.

**James Dillon** (1902-1986) was the son of John Dillon. He was the leader of the Fine Gael Party in Dáil Éireann from 1959 to 1965. He was born near Dublin.

**DiMaggio, Joe** (1914- ), was one of the greatest outfielders in baseball history. He played his entire career, from 1936 to 1951, with the New York Yankees. DiMaggio was nicknamed "the Yankee Clipper" because of his graceful fielding and "Joltin' Joe" because of his powerful hitting. He played in 10 World Series and in 11 All-Star games. He was voted the American League's most valuable player in 1939, 1941, and 1947. In 1948, DiMaggio led the league with 39 home runs and 155 runs batted in.

Joseph Paul DiMaggio was born in California. Two of his brothers, Dominic and Vincent, also played major league baseball. DiMaggio was briefly married to film star Marilyn Monroe in 1954. He was elected to the National Baseball Hall of Fame in 1955.

**Dinefwr** (pop. 38,000) is a local government district in Dyfed in southwest Wales. It includes Ammanford, Cwmamman, Llandeilo, and Llandovery. Dinefwr is a district of hills and valleys. Hill farmers breed sheep, while the farmers in the valleys breed dairy cattle, pigs, and poultry. Forestry is also important in the district. Dinefwr's industries include coal mining, engineering, and production of a wide range of items, from springs to clothing. Llanybyddie is a notable publishing centre. Llandovery has a ruined castle from the 1200's and a Welsh public school.

See also **Dyfed**.

**Dinesen, Isak** (1885-1962), was the pen name of Baroness Karen Blixen-Finecke, a Danish author who wrote in English and Danish. Her stories deal with fantastic, unreal, often grotesque people and situations. She had a deep concern for the supernatural, and she preferred to portray life in romantic settings of the past. Her volumes of short stories include *Seven Gothic Tales* (1934), *Winter's Tales* (1942), *Last Tales* (1957), *Anecdotes of Destiny* (1958), and *Ehregard* (1963). She also wrote two books of memoirs, *Out of Africa* (1937) and *Shadows on the Grass* (1961).

Born Karen Christence Dinesen in Rungsted, Denmark, she was married to Baron Bror Blixen-Finecke in 1914, and divorced in 1921. She owned a coffee plantation in eastern Africa, and lived there from 1914 to 1931. Then she returned to Denmark.

**Ding Ling** (1904-1986), also spelled *Ting Ling*, the pen name of Jiang Bingzhi, or Chiang Wei-chi, one of modern China's most popular and controversial writers. She was born in Changde, Yunan Province. She began writing in the 1920's after moving to Shanghai. Influenced by Western literature and anarchic and left-wing politics, Ding Ling wrote three collections of short stories portraying the lonely lives of unconventional, unfulfilled women.

In the 1930's, Ding joined the Communist Party and was imprisoned by Chiang Kai-shek's Nationalist government for three years. She escaped in 1936 and joined the Communists in northern China. When the Communists took power in 1949, Ding held many cultural posts. Her novel *The Sun Shines over the Shang-kan River* won the 1951 Stalin Prize in the Soviet Union.

In 1957, she was condemned for criticizing the Communists over women's rights and exiled to a farm in northern China. Her work was banned and she was held in solitary confinement from 1970 to 1975. In 1979, the government lifted the ban on her work.



**Dingane** (1795-1840) was king of the Zulu from 1828 to 1840. He was born in Babanango, in what is now the South African province of Kwazulu-Natal. He became the leader of the Zulu after helping to assassinate his half-brother Shaka (see **Shaka**). In the late 1830's, a group of **Boers** (Dutch farmers) from the Cape Colony wanted to acquire land in Natal, to the south of the Zulu territory. In 1838, Dingane signed a treaty with Piet Retief, the leader of the **Voortrekkers** (settlers), and gave Natal to them. But soon afterward, Dingane executed Retief and his delegation at Mgungundhlovu, the Zulu capital. One of Dingane's armies was eventually defeated by a Boer force at the Battle of Blood River in 1838. Dingane set fire to his capital and fled northward. In 1840, his half-brother Mpande allied with the Boers to destroy him. Fleeing across the Phongolo River in present-day Swaziland, Dingane was trapped and stabbed to death.

**Dingo** is the wild dog of Australia. Researchers believe that dingoes were brought to Australia more than 7,000 years ago by **Aborigines**, the first people to live in Australia.

Dingoes are about as large as English setters. They have alert faces; sharp, erect ears; and brushlike tails. Most dingoes have yellowish-brown fur, but the animal's colours range from yellowish-white to black. Dingoes rarely bark, but howl instead. If dingoes are caught



The dingo is a wild dog that lives in Australia.

as puppies, they make good pets. Scientists regard dingoes and domestic dogs as the same species. But purebred dingoes have more massive skulls and jawbones. The canines and the side cutting teeth are larger.

Dingoes hunt alone or in family groups. Their most important food is the **wallaby** (small kangaroo), but they also kill sheep. As a result, the Australian government has spent much money to fence out dingoes and to poison them.

**Scientific classification.** The dingo belongs to the dog family, Canidae. It is *Canis dingo*.

**Dinka** are a cattle-herding people of central Africa. They make up the largest black ethnic group in Sudan. Most of the approximately 2 million Dinka live on the plains of southern Sudan. Besides herding cattle, they also fish and grow crops. Their main crop is a grain called **millet**. Their diet also includes fish, milk, and veg-

etables. The Dinka obtain milk from their cattle but do not kill the animals for meat.

The Dinka religion includes belief in a supreme god called **Nhialic** and many spirits. Ritual leaders called **masters of the fishing spear** lead religious ceremonies and settle disputes. These leaders trace their descent to a leader called Awiel Longar, the original spear master. The Dinka believe that the masters of the fishing spear have spiritual power, which the masters use to provide health and prosperity for their people. Some Dinka have become Christians or Muslims and do not practise their traditional religion.

The Dinka language belongs to the Nilotic family of African languages. Many of the Dinka people also speak English.

The United Kingdom and Egypt made Sudan a protectorate in 1899 and ruled the country until it won independence in 1956. Arabic-speaking Muslims from northern Sudan controlled the new government. The Dinka and other southern peoples have rebelled several times against northern control.

**Dinkins, David Norman** (1927- ), became the first black mayor of New York City. In 1990, he replaced Edward Koch as mayor of the largest city in the United States. Dinkins, a Democrat, defeated Rudolph Giuliani in the 1989 general election with support from the city's black voters. Dinkins is a liberal who became known for his skill in resolving conflicts. He was defeated by Giuliani in elections in 1993 and left office in 1994.

Dinkins was born in Trenton, New Jersey. He earned a bachelor's degree in mathematics from Howard University in Washington, D.C. In 1956, he graduated from Brooklyn Law School. Dinkins was elected to the New York Legislature in 1965 and served one term. He was city clerk of New York City from 1975 to 1985. He then was elected president of Manhattan, one of the five boroughs of New York City.

**Dinoflagellate** is a kind of single-celled organism found throughout the oceans and in freshwater lakes and ponds. Dinoflagellates make up part of the drifting mass of water organisms known as **plankton** (see **Plankton**). Some dinoflagellates need only sunlight and inorganic nutrients for growth. Others engulf bacteria and other tiny organisms.

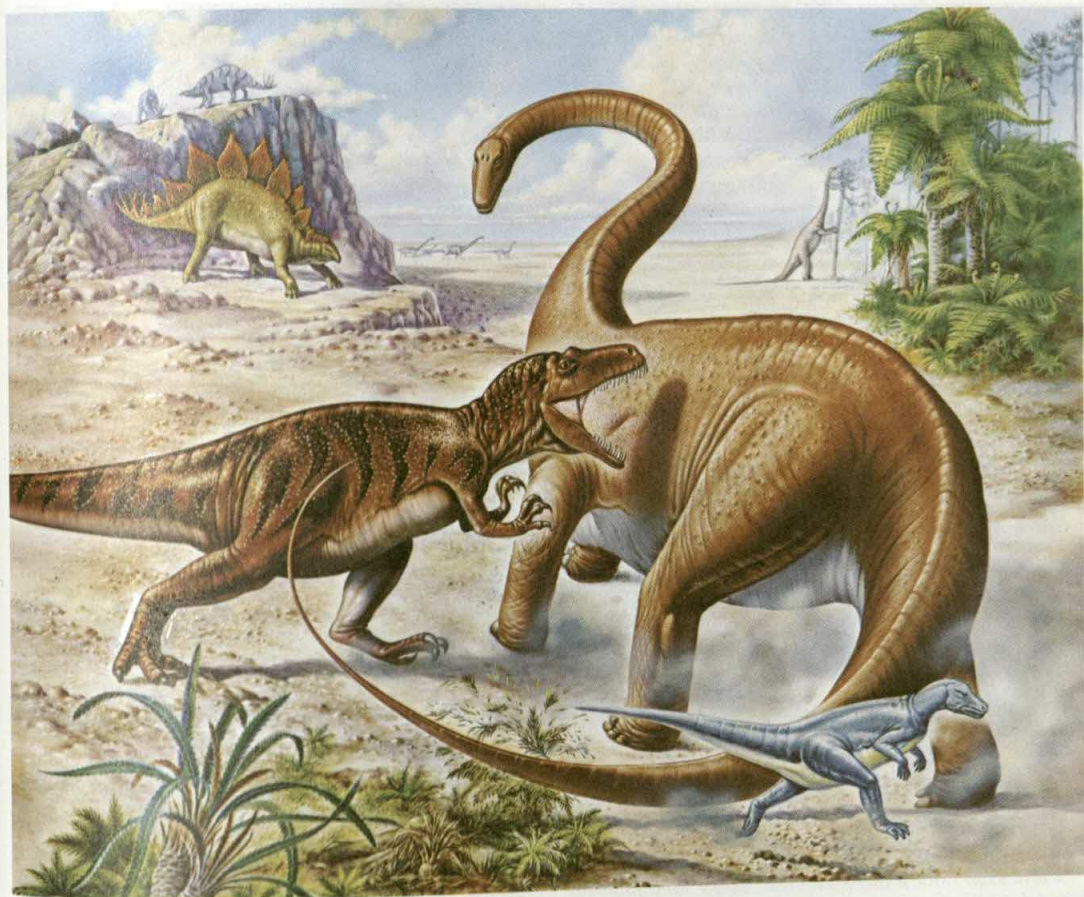
Dinoflagellates have two **flagella** (long, hairlike projections) that enable them to swim. Some dinoflagellates produce a chemical light called **bioluminescence**. Some also are toxic and can kill fish and poison shellfish. When dinoflagellates become abundant, they may discolour the water, producing red tides (see **Red tide**).

**Scientific classification.** Dinoflagellates traditionally have been classified in the animal subkingdom Protozoa by zoologists and in the plant phylum Pyrrophyta by botanists. Today, many zoologists and botanists consider dinoflagellates to be protists and classify dinoflagellates in the kingdom Protista.



Dinoflagellates





Dinosaurs of the Jurassic Period (205 million to 138 million years ago) included the huge *Diplodocus*, above right. Other dinosaurs included the plated *Stegosaurus*, upper left, *Allosaurus*, centre, and *Camptosaurus*, lower right.

## Dinosaur

**Dinosaur** is the name of a kind of reptile that lived millions of years ago. The word *dinosaur* comes from two Greek words meaning *terrible lizard*. Dinosaurs were not lizards. But the size of some dinosaurs was terrifying. The biggest ones were the largest animals ever to live on land. They weighed more than 10 times as much as a full-grown elephant. Only a few kinds of whales grow to be larger than these dinosaurs.

The first dinosaurs appeared on the earth around 220 million years ago. For about 150 million years, they ruled the land. They lived in most parts of the world and in a variety of surroundings, from swamps to open plains. Then about 63 million years ago, dinosaurs died out rather suddenly.

Dinosaurs varied greatly in size, appearance, and habits. But the most famous kinds include such giants as *Apatosaurus*, *Diplodocus*, and *Tyrannosaurus*. *Apatosaurus*, also called *Brontosaurus*, grew about 21 metres long. *Diplodocus* grew even longer—to about 27 metres. Both *Apatosaurus* and *Diplodocus* were plant-eaters. They had a small head and an extremely long neck and

tail. *Tyrannosaurus* was a fierce meat-eater. It stood almost 3 metres tall at the hips and had an enormous head and long, pointed teeth. But not all dinosaurs were giants. The smallest dinosaur was about the size of a chicken.

In some ways, dinosaurs were like most present-day reptiles. For example, some had teeth, bones, and skin like those of crocodiles and other reptiles living today. Many probably were also about as intelligent as crocodiles. But dinosaurs differed from present-day reptiles in other ways. For example, no modern reptiles grow as large as large dinosaurs. Another important difference is in posture. The legs of lizards, turtles, and most other reptiles are pushed out to the sides of the body. The structure of the legs gives the animals a sprawling posture. But a dinosaur's legs were under the body like the legs of a horse. This leg structure lifted the dinosaur's body off the ground and enabled some kinds to walk on their hind legs.

Dinosaurs lived during most of the *Mesozoic Era*, a time in the earth's history that lasted from about 240 million to 63 million years ago. The Mesozoic Era is also called the *Age of Reptiles* because reptiles ruled the land, sea, and sky during that time. The most important





**Dinosaurs of the Cretaceous Period** (138 million to 63 million years ago) included *Tyrannosaurus*, upper left, and the horned *Triceratops*. Two ankylosaurs stand in the foreground. Flowering plants appeared during this period, and opossums, snakes, and lizards were common.

reptiles belonged to a group of animals called *archosaurs* (ruling reptiles). In addition to dinosaurs, this group included *thecondonts*, the ancestors of the dinosaurs; crocodiles; and flying reptiles. By the close of the Mesozoic Era, all archosaurs except crocodiles had died out, and the Age of Reptiles ended.

Scientists do not know why dinosaurs disappeared. For many years, they thought that dinosaurs had left no *descendants* (offspring). But scientists now believe that birds descended from small meat-eating dinosaurs.

Scientists learn about dinosaurs by studying dinosaur *fossils*—that is, the preserved bones, teeth, eggs, and tracks of dinosaurs. They also study living reptiles and other animals that resemble dinosaurs in some ways.

### The world of the dinosaurs

When dinosaurs lived, the earth was much different from the way it is today. For example, the Alps, the Himalaya, and many other surface features had not yet been formed. The first flowering plants did not appear until late in the Mesozoic Era. The mammals of the Mesozoic Era were extremely small, and many of the plants and animals that were common then are now rare or extinct.

**Land and climate.** Scientists believe that the conti-

nents once formed a single land mass surrounded by an enormous sea. During the Mesozoic Era, this land mass began to break up into continents. The continents slowly drifted apart toward their present locations. But for many centuries, dinosaurs could wander freely over the land connections between continents.

As the continents moved apart, their surface features and climate changed. For a time, shallow seas covered much of North America, Europe, and southern Asia. Thick forests bordered drier plains, and swamps and deltas lined the seacoasts. Later in the Mesozoic Era, the Rocky Mountains began to form, and the seas drained from North America.

Throughout much of the Mesozoic Era, dinosaurs probably lived in an almost tropical climate. Areas near the seas may have had mild, moist weather all year. Inland regions probably had an annual dry season. Toward the end of the Mesozoic Era, the climate grew cooler and drier.

**Plant and animal life** also changed during the Mesozoic Era. During the first half of the era, *conifers* (cone-bearing trees) were the most common plants. Other plant life consisted mainly of cycads, ferns, mosses, and tree ferns. Land animals, in addition to di-



nosaurs, included crocodiles, frogs, insects, lizards, turtles, and a few kinds of small mammals. Reptiles called *ichthyosaurs* and *plesiosaurs* lived in the seas, along with such animals as clams, corals, jellyfish, snails, sponges, squids, starfish, and sharks and other fish. *Pterosaurs* were reptiles that had wings and could fly.

By the end of the Age of Reptiles, flowering plants had become common. Trees of the forests included cypresses, ginkgoes, maples, oaks, palms, poplars, and redwoods. Birds had developed, and the first snakes appeared. Sea animals included modern fish, plus 3.7-metre sardines, huge turtles, and gigantic lizards called *mosasaurs*.

### Kinds of dinosaurs

Scientists divide the dinosaurs into two major groups: (1) saurischians and (2) ornithischians. The two groups differed in the structure of the hips. Saurischians, whose name means *lizard-hipped*, had a hip structure much like that of lizards. Ornithischians, whose name means *bird-hipped*, had a birdlike hip structure. Each of the groups consisted of several basic kinds of dinosaurs.

Some kinds of dinosaurs lived during all three periods into which the Mesozoic Era is divided. Other kinds lived in one or two of the periods. The periods are the *Triassic*, the *Jurassic*, and the *Cretaceous*. The Triassic Period lasted from about 240 million to 205 million years ago. The Jurassic Period lasted from about 205 million to 138 million years ago. The Cretaceous Period lasted from about 138 million to 63 million years ago.

**Saurischians** included both the largest and the fiercest dinosaurs. There were three basic kinds of saurischians: (1) prosauropods, (2) sauropods, and (3) theropods. Each of these groups included many variations.

**Prosauropods**, such as *Plateosaurus*, grew about 6 metres long and had a long neck and a small head. Prosauropods walked on their hind legs sometimes and on

all four legs at other times. They were the first common plant-eating dinosaurs. They appeared about 220 million years ago and apparently died out early in the Jurassic Period.

**Sauropods** were the giants of the dinosaur world. The largest ones included *Ultrasaurus*, which some scientists believe stood 17 metres tall when standing erect, and *Seismosaurus*, which probably grew to a length of about 45 metres. Most sauropods stood 4.8 to 12 metres tall when standing erect. Most adults weighed from 9 to 27 metric tons. Sauropods walked on four heavy legs like those of an elephant. A typical sauropod had a long neck, a small head, a long tail, and a huge, deep chest. Sauropods were the main plant-eaters of the Jurassic Period. During the Cretaceous Period, other plant-eaters became more important.

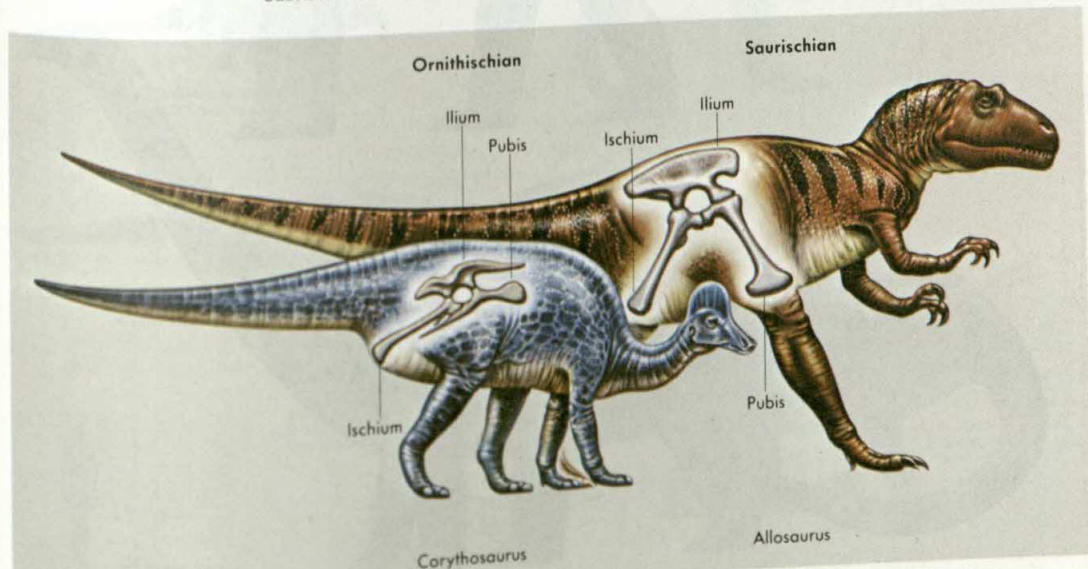
One of the best-known sauropods is *Apatosaurus*, or *Brontosaurus*. For many people, the word *dinosaur* brings to mind the image of *Apatosaurus*. The animal's front legs were shorter than its hind legs, and its back sloped down toward the base of the neck. *Diplodocus* looked much like *Apatosaurus* but was slimmer and lighter. *Diplodocus* grew as long as 27 metres. Both *Apatosaurus* and *Diplodocus* lived during the Jurassic Period in what is now North America.

**Brachiosaurus**, another type of sauropod, lived in many parts of the world during the Jurassic Period. *Brachiosaurus* stood 12 metres tall or more and weighed up to 77 metric tons. Its front legs were longer than the back ones. It stood like a giraffe, with the back sloping down toward the tail.

**Theropods** were the only meat-eating dinosaurs. The animals walked upright on two hind legs. Typical theropods had a long, muscular tail, which they carried straight out behind them for balance. Their forelimbs were slender. Large theropods had a short neck and a large, long head. Small theropods had a long neck and a

### Kinds of dinosaurs

Scientists divide dinosaurs into two major groups—ornithischians and saurischians—according to the structure of the hips. Ornithischians, such as *Corythosaurus*, had a birdlike hip structure. Saurischians, such as *Allosaurus*, had a hip structure much like that of lizards.





## When dinosaurs lived

Dinosaurs lived during most of the Mesozoic Era, which is divided into three periods—the Triassic (240 million to 205 million years ago), the Jurassic (205 million to 138 million years ago), and the Cretaceous (138 million to 63 million years ago). The illustrations that appear below and on the next page include dinosaurs from each of these periods.



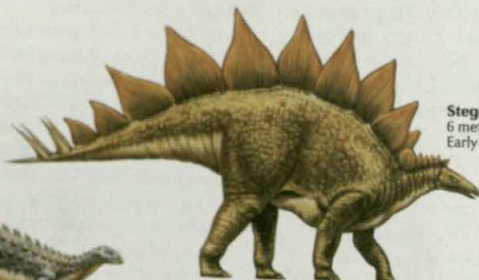
**Plateosaurus**  
6 metres long  
Late Triassic



**Procompsognathus**  
0.9 metre long  
Late Triassic



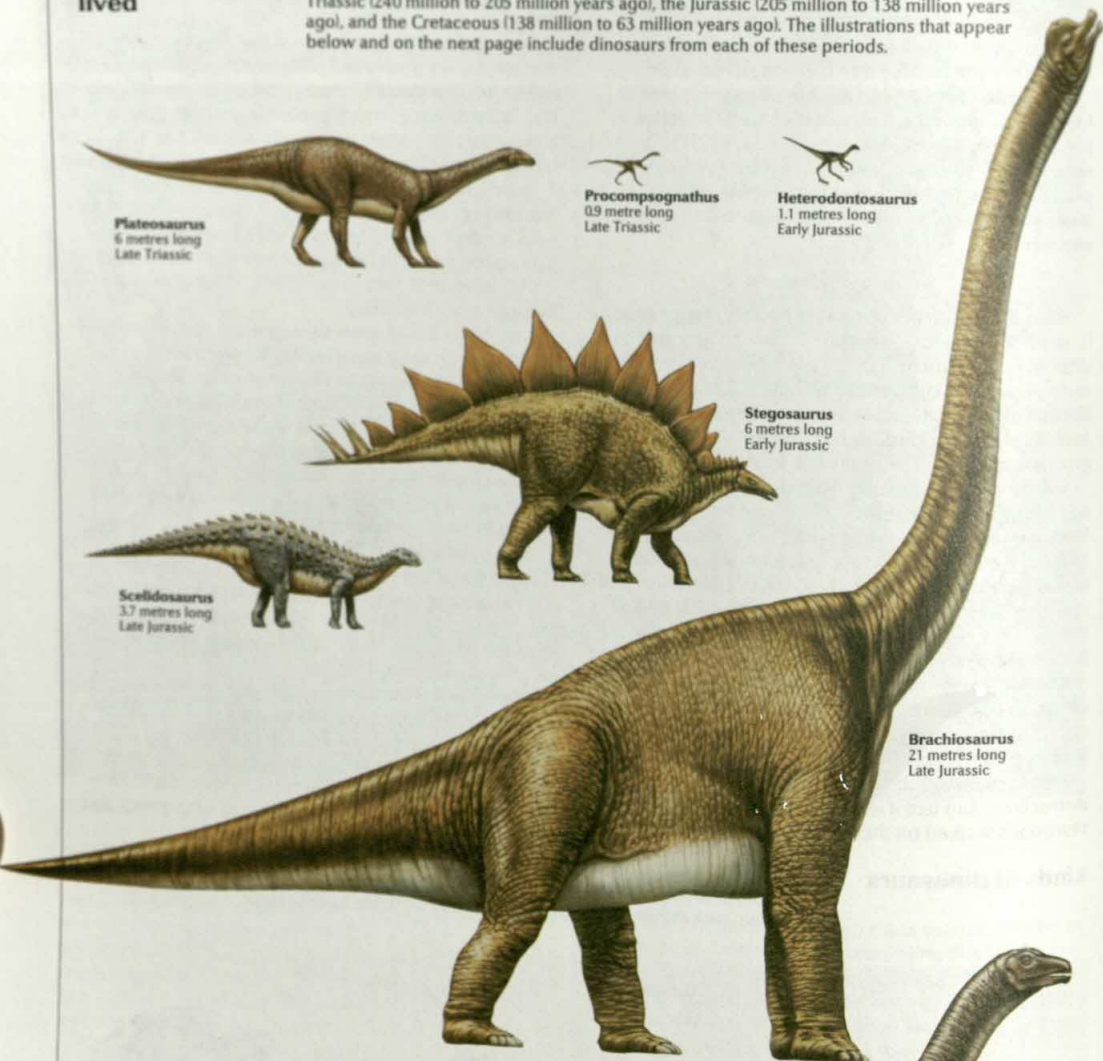
**Heterodontosaurus**  
1.1 metres long  
Early Jurassic



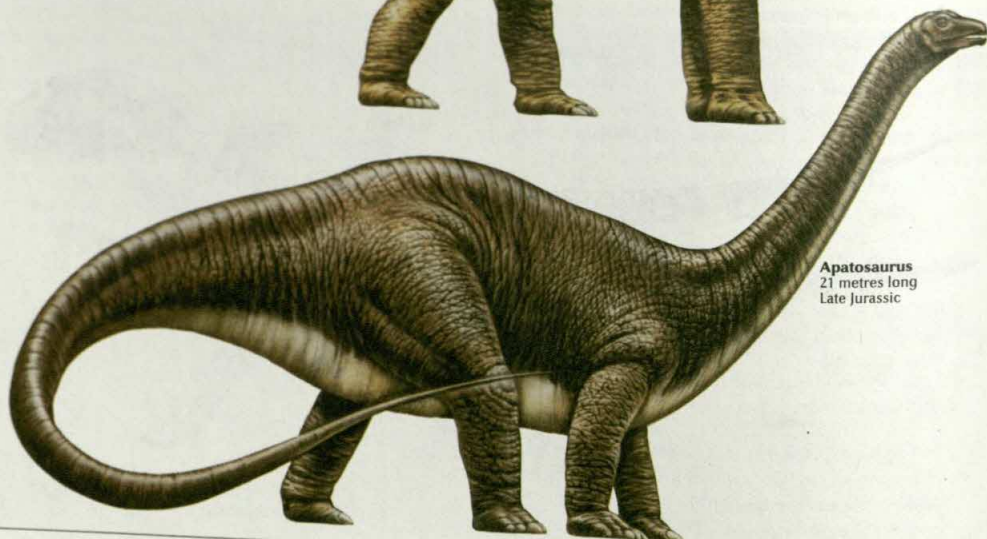
**Stegosaurus**  
6 metres long  
Early Jurassic



**Spinosaurus**  
3.7 metres long  
Late Jurassic



**Brachiosaurus**  
21 metres long  
Late Jurassic



**Apatosaurus**  
21 metres long  
Late Jurassic





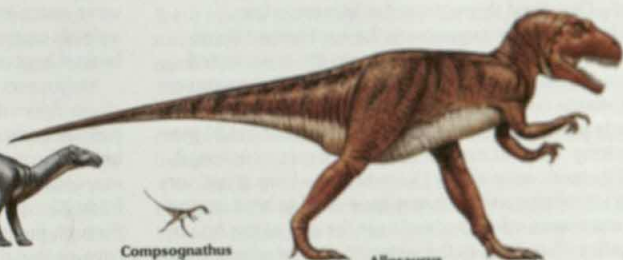
**Ornitholestes**  
1.8 metres long  
Late Jurassic



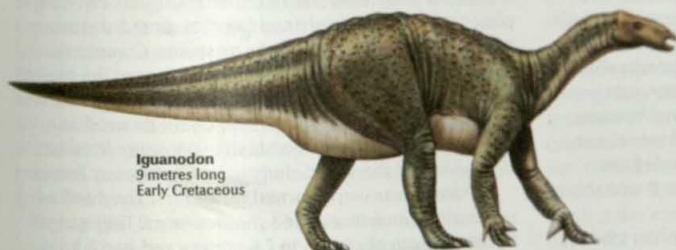
**Camptosaurus**  
4.8 metres long  
Late Jurassic



**Compsognathus**  
0.8 metre long  
Late Jurassic



**Allosaurus**  
9 metres long  
Late Jurassic



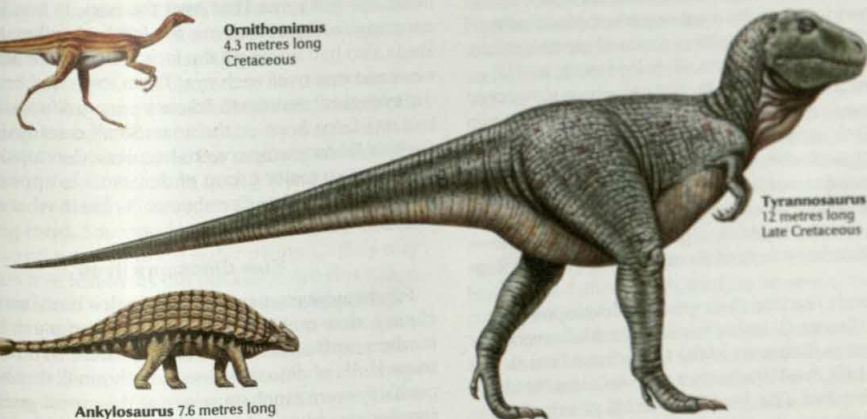
**Iguanodon**  
9 metres long  
Early Cretaceous



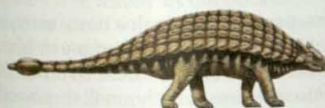
**Deinonychus** 2.7 metres long  
Early Cretaceous



**Ornithomimus**  
4.3 metres long  
Cretaceous



**Tyrannosaurus**  
12 metres long  
Late Cretaceous



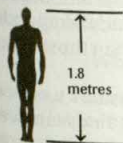
**Ankylosaurus** 7.6 metres long  
Late Cretaceous



**Corythosaurus**  
9 metres long  
Late Cretaceous



**Pentaceratops**  
7.6 metres long  
Late Cretaceous





smaller head. Theropods had strong jaws and bladelike teeth. They lived throughout the Mesozoic Era.

The fierce tyrannosaurs are the best-known theropods. One kind, *Tyrannosaurus*, was the most feared meat-eater of its time. Its scientific name, *Tyrannosaurus rex*, means *tyrant-lizard king*. *Tyrannosaurus* stood nearly 3 metres high at the hips and grew about 12 metres long. Its head measured up to 1.4 metres in length, and its teeth were about 15 centimetres long. It had very short forelimbs, which it may have used to hold its prey. Tyrannosaurs ruled the land near the end of the Age of Reptiles. They lived in the western parts of what are now North America and Mongolia.

About 150 million years ago, long before tyrannosaurs appeared, allosaurs were the main meat-eating dinosaurs. They resembled tyrannosaurs but were not quite as large. Allosaurs also had longer forelimbs with three fingers on each. Smaller theropods included *Deinonychus* and *Ornithomimus*. *Deinonychus* was about 0.9 metre tall. On each foot, it had a large curved claw, which it probably used to slash at prey. *Ornithomimus* looked much like a featherless ostrich and was about the size of an ostrich. Theropods also included the smallest known dinosaur, *Compsognathus*. It was about the size of a chicken.

**Ornithischians** were plant-eaters. They had a beak-like bone in front of their teeth, and many had bony plates in their skin. During the Cretaceous Period, ornithischians became the most important plant-eating dinosaurs. There were four basic kinds of ornithischians: (1) ornithopods, (2) stegosaurs, (3) ankylosaurs, and (4) ceratopsians. Each group included numerous variations.

**Ornithopods** could walk either on four legs or on two hind legs. One of the first dinosaur fossils discovered was that of *Iguanodon*, a kind of ornithopod. *Iguanodon* measured about 9 metres long. They had a bony spike on the thumb of each forelimb. Some ornithopods, such as *Hypsilophodon*, grew only 1.5 to 2.1 metres long. Ornithopods lived throughout the Age of Reptiles.

Ornithopods reached their greatest development in duckbilled dinosaurs, or hadrosaurs. Duckbills were the most numerous dinosaurs of the Cretaceous Period. Most duck bills lived in what are now Asia and North America. They had a flat beak like the bill of a duck at the front of the mouth and jaws with hundreds of teeth farther back in the mouth. They had strong hind legs, and long, slender front legs with webbed toes. Duckbills grew up to 2.7 metres tall at the hips and more than 9 metres long.

Some kinds of duckbills, such as *Anatosaurus*, had a low, flat skull. Other kinds, such as *Corythosaurus*, had a showy, bony *crest* (growth) on the top of the head. Air passages from the animal's nose travelled through the crest. Some scientists believe that the crested duckbills may have made honking sounds by using the air passages much like a trumpet.

**Stegosaurs** were large plant-eaters with huge, upright bony plates along the back. They lived about 150 million years ago. One of the best-known stegosaurs is *Stegosaurus*, which lived in what is now North America. Other kinds lived in what are now Africa, Europe, India, and China. Stegosaurs walked on four legs. They were about 6 metres long and about 2.4 metres tall at the hips.

They had a small head and a short neck. Their hind legs were much longer than the front ones. As a result, the animals carried the head close to the ground and looked bent over.

Stegosaurs had one or two rows of vertical, bony plates down the back. Their tail was armed with two pairs of bony spikes. The plates and spikes may have helped protect the animals from enemies. The plates may also have served as part of a system to cool the body. Blood warmed in the body probably flowed through the thin plates. Air moving around its back may have cooled the blood flowing through the plates.

**Ankylosaurs** are known as the armoured dinosaurs. They were low, broad animals and walked on four legs. Most kinds of ankylosaurs grew 4.8 to 7.6 metres long and had a skull more than 0.6 metre long. Heavy, bony plates covered the body and head of most ankylosaurs. Many of the plates had ridges or spikes. Commonly, large spikes also grew at the shoulders or at the back of the head. Some kinds of ankylosaurs had a large mass of bone at the end of the tail, which could be used as a powerful club against enemies. Ankylosaurs lived in many parts of the world during the Cretaceous Period.

**Ceratopsians** were horned dinosaurs. They walked on four feet and resembled rhinoceroses. They ranged in length from about 1.8 to 7.6 metres and had a huge head. Ceratopsians had a bony frill on the back of the head. The frill spread out over the neck. In one kind of ceratopsian, *Styracosaurus*, the frill had spikes. Most kinds also had horns on the face, usually one on the nose and one over each eye. *Triceratops* had horns over the eyes that grew up to 0.9 metre long. *Monoclonius* had one large horn on the nose. Small ceratopsians, such as *Protoceratops*, were hornless. Ceratopsians were the last major group of dinosaurs to appear. They lived during the late Cretaceous Period in what are now Asia and North America.

### How dinosaurs lived

For many years, people thought that dinosaurs were clumsy, slow-moving creatures that lived much like modern reptiles. However, fossil evidence shows that some kinds of dinosaurs—especially small theropods—probably were much more active than most present-day reptiles. In addition, most dinosaurs resembled birds, rather than modern reptiles, in their leg and foot structure and upright posture. Scientists generally agree that dinosaurs are closer ancestors of birds than of present-day reptiles. They believe that the study of birds can help us learn about the life of dinosaurs.

How dinosaurs lived depends partly on whether they were *ectothermic* (cold-blooded), like modern reptiles, or *endothermic* (warm-blooded), like birds. The body temperature of ectothermic animals changes with the temperature of their surroundings. For example, a lizard's body temperature rises as the air becomes warmer. If the air cools, the lizard loses body heat. Endothermic animals have a constant, fairly warm body temperature. Such animals tend to be more active than those whose temperature varies.

Scientists disagree on whether dinosaurs were ectothermic or endothermic. Traditionally, dinosaurs were considered to be ectothermic. But most scientists now believe that some dinosaurs must have been endother-



mic to keep up their level of activity. Other experts point out, however, that large animals lose body heat very slowly. The large dinosaurs could therefore have had a warm, constant body temperature and been fairly active even if they were ectothermic.

**Reproduction and growth.** Scientists do not know how all dinosaur species reproduced. However, fossil dinosaur eggs have been discovered. Therefore, at least some kinds of dinosaurs laid eggs, as do most other reptiles. The female may have scratched a nest in the soil and deposited one dozen to two dozen eggs in it. Some dinosaurs may have cared for their young after they hatched. Others probably left them to survive as best they could.

Scientists can only guess how old dinosaurs lived to be. But they can estimate the time it took for dinosaurs to grow to adult size. The growth rate depends on whether dinosaurs were endothermic or ectothermic. Endothermic animals grow more rapidly than do ectothermic ones. If apatosaurs were endothermic, it probably took them about 30 years to reach their adult weight of about 27 metric tons. If the animals were ectothermic, however, it may have taken them 200 years or longer to grow that large.

**Group life.** Fossil evidence shows that more than 20 kinds of dinosaurs may have occupied a particular area at the same time. Many kinds, including ceratopsians, duckbills, and stegosaurs, lived in herds. Other kinds, such as apatosaurs and tyrannosaurs, probably spent most of their life alone or in small groups.

Some experts think that dinosaurs, like many modern birds and reptiles, were colourful animals. Some kinds of dinosaurs perhaps attracted mates by displaying brightly coloured body parts. For example, a duckbill's head crest and a ceratopsian's neck frill may have been vividly coloured and so served to attract mates.

**Getting food.** Sauropods may have waded into shallow lakes and swamps to eat water plants. Or they may have eaten tree leaves, as did duckbills. Ankylosaurs, ceratopsians, and stegosaurs fed on low plants that grew along shorelines or on open plains.

Allosaurs, tyrannosaurs, and other large theropods may have been hunters that preyed mainly on the huge plant-eating dinosaurs. Or these giant meat-eaters, like some other theropods, might have been *scavengers* and picked meat from dead animals they found. Some small theropods ate insects or eggs. Others hunted mammals or small dinosaurs and other reptiles. These small theropods were probably very active and could run quickly. Some of them, including the fierce *Deinonychus*, may have hunted in packs as wolves do today.

**Protection against enemies.** Plant-eating dinosaurs had many forms of protection against theropods. The huge size of sauropods probably protected them from most predators. Ankylosaurs had bony plates for protection, and ceratopsians and stegosaurs probably used their horns and spikes to fight off enemies. Duckbills could swim into deep water to flee from theropods.

### Why dinosaurs died out

For about 150 million years, dinosaurs ruled the land, and other large reptiles ruled the sky and sea. Then about 63 million years ago, these huge reptiles died out and mammals took over the earth.

Scientists have developed many theories to explain these events. Some experts believe that plant-eating dinosaurs could not eat the new kinds of plants that developed during the Cretaceous Period and thus starved. As they died off, so did the meat-eaters that preyed on them. Other experts think that the dinosaurs could not compete successfully with mammals for food and so lost the struggle for existence.

Probably the most widely accepted theory involves a change in the earth's climate. Toward the end of the Cretaceous Period, the climate cooled and winters may have become too cold for the dinosaurs. Dinosaurs were too large to hibernate in dens, and they had no fur or feathers for protection against the cold. The cold also may have upset dinosaur reproductive patterns. Studies of modern alligators, crocodiles, and turtles indicate that the temperature of the nest of these reptiles determines the sex of their offspring. Warmer or cooler temperatures produce either all male or all female offspring. Therefore, cooling temperatures in the nesting grounds of dinosaurs may have caused offspring of only one sex to be produced. With no mates of the opposite sex, dinosaurs died out.

Another theory suggests that a large asteroid hit the earth at the end of the Cretaceous Period. According to this theory, the impact of the asteroid threw billions of tons of dust—or ice crystals, if the asteroid had hit the ocean—into the atmosphere. Heat from the impact may have caused huge fires worldwide. A cloud of smoke and debris blocked out sunlight for months. The seeds and roots of land plants survived this lightless period, but the plants themselves stopped growing. The lack of plant growth killed off many of the plant-eating dinosaurs. As the plant-eaters died, so also did the meat-eating dinosaurs that fed on them. The darkness caused land temperatures to drop below freezing for 6 to 12 months. This change in climate further damaged the dinosaur populations. Scientists theorize that small mammals and birds were protected from the cold by fur or feathers and survived by feeding on seeds, nuts, and rotting vegetation.

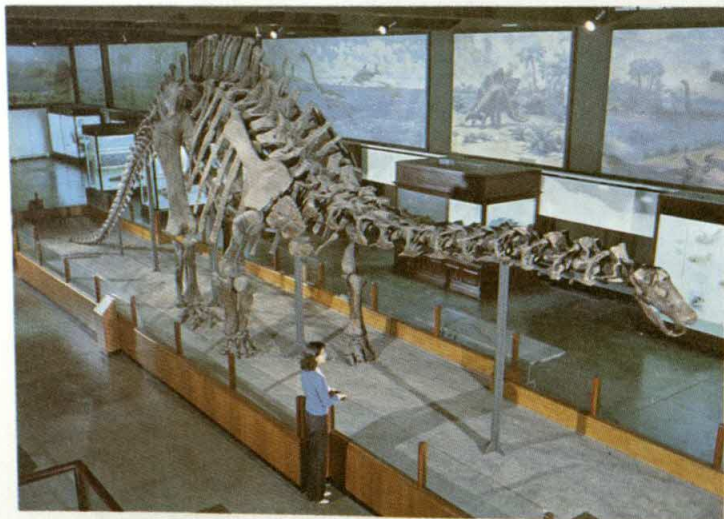
Some scientists believe that not all dinosaurs became extinct at the end of the Cretaceous Period. Scattered bones found at sites in the United States, Peru, India, and China indicate that some dinosaurs may have survived during the early part of the Age of Mammals.

Many scientists feel that no one theory completely explains why dinosaurs died out. They suggest that dinosaurs simply could not keep up with the changes that were occurring on the earth toward the end of the Cretaceous Period. Thus, a combination of causes may have contributed to the end of the Age of Reptiles.

### Learning about dinosaurs

Scientists who study prehistoric life are called palaeontologists. They have many ways of learning about dinosaurs. One important way is by studying dinosaur fossils. For example, a single dinosaur tooth can tell an expert whether the animal ate plants or meat and how big it was. Palaeontologists also learn about dinosaurs by observing animals that have traits similar to those of dinosaurs. For example, they might study elephants and hippopotamuses in the wild to learn about the lives of large land animals.





**The reconstructed skeleton of an *Apatosaurus*, left, makes a stunning exhibit in a museum. Scientists rebuild dinosaur skeletons by fitting together fossilized dinosaur bones and teeth. These skeletons help people visualize how dinosaurs may have looked. The fossilized eggs shown above were laid by *Protoceratops*. They are about 16 centimetres long.**

**Dinosaur discoveries.** Before the 1800's, no one knew that dinosaurs had ever existed. People who found a dinosaur tooth or bone did not know what it was. Then in 1822, Mary Ann Mantell, the wife of Gideon Mantell, an English doctor, found a large tooth partly buried in a rock. She showed the tooth to her husband, who collected fossils. He learned that the tooth resembled that of a South American lizard called an *iguana*. He suggested that the tooth came from a huge, iguanalike reptile, which he named *Iguanodon* (iguana tooth).

Within a few years, the remains of several other kinds of large, extinct reptiles had been discovered. In 1841, Sir Richard Owen, an English scientist, suggested that these reptiles belonged to a group of reptiles that were unlike any living animals. Owen called the group *Dinosauria*. Its members came to be known as dinosaurs.

During the late 1800's and early 1900's, large deposits of dinosaur remains were discovered in western North America, Europe, Asia, and Africa. One of these deposits lies in the Morrison Formation, a series of rock layers in the United States extending across part of Colorado, Utah, and Wyoming. Today, most dinosaur discoveries are made in China, Mongolia, Argentina, and Australia. Some also occur in the United States and Canada. An average of six new kinds of dinosaurs are described every year.

**Working with dinosaur fossils.** Museums and other educational institutions sponsor scientists who search for and study dinosaur fossils. Palaeontologists look for fossils in areas where wind and water have worn away the land and exposed deep, fossil-bearing layers of rock. After they locate a skeleton, palaeontologists remove the rock above the fossil. In many cases, they dig out the portion of the rock that contains the fossil. Then they cover the rock and fossil with cloth and plaster of Paris. The plaster dries into a hard, protective coating, and the fossil is shipped to a laboratory. At the laboratory, workers clean the bones and teeth and repair broken ones. Specialists may then rebuild the skeleton by putting the bones together on a metal frame. In some cases, missing bones may be replaced with pieces made from fibreglass, plaster, or plastic. Sci-

entists rarely discover all the bones of a large dinosaur, and so they estimate the animal's length based on the bones that have been found.

Some museums make models of dinosaurs for display. Experts study the skeleton and try to imagine how it looked covered with muscles and skin. They then build a metal frame that resembles the skeleton and mould wire and screen around it to shape the dinosaur's body. Finally, they cover the model with "skin" and paint it to look realistic.

**Related articles.** For additional information and pictures of dinosaurs, see *Prehistoric animal*. See also: Andrews, Roy Chapman; Palaeontology; Earth (The Mesozoic Era); Pterosaur; Fossil; Reptile

### Outline

#### I. The world of the dinosaurs

- A. Land and climate
- B. Plant and animal life

#### II. Kinds of dinosaurs

- A. Saurischians
- B. Ornithischians

#### III. How dinosaurs lived

- A. Reproduction and growth
- B. Group life
- C. Getting food
- D. Protection against enemies

#### IV. Why dinosaurs died out

#### V. Learning about dinosaurs

- A. Dinosaur discoveries
- B. Working with dinosaur fossils

### Questions

- What are some theories that scientists have developed to explain why dinosaurs died out?
- How did sauropods get food?
- What were some kinds of dinosaurs that probably lived in herds?
- In what kind of area do palaeontologists look for dinosaur fossils?
- What were the two major groups of dinosaurs? How did they differ?
- Which dinosaurs were meat-eaters?
- Where are most dinosaur discoveries made today?
- Where have some of the most important dinosaur fossil deposits been discovered?
- What kinds of animals besides dinosaurs lived during the Age of Reptiles?



**Diocese.** See Archbishop; Bishop; Roman Catholic Church (Dioceses and parishes).

**Diocletian**, a Roman emperor, was born about A.D. 245 and died in 313. He divided the empire into four regions called *prefectures*. He shared the rule with three other men. Diocletian is remembered for his persecutions of Christians, beginning in 303.

Diocletian's official name was Gaius Aurelius Valerius Diocletian. He was born in Dalmatia, a Roman province on the eastern side of the Adriatic Sea. Diocletian became a general, and was proclaimed emperor by his troops in 284. In 286, he made Maximian his co-emperor. In 293, he gave two other men each authority over a prefecture, creating a four-man rule that lasted until 305. Diocletian and Maximian then gave up their power. The shared rule, though effective, was unpopular because it increased the size of government and raised taxes.

**Diode.** See Electronics (Switching; The first commercial vacuum tubes); Vacuum tube (Kinds).

**Diogenes** (412?-323 B.C.) belonged to the Cynic school of ancient Greek philosophy. The Cynics took their name from the Greek word for "the dog," which was Diogenes' nickname. The Cynics taught that a person should lead a life of self-control and be free from all desire for material things and pleasures. Diogenes carried this view to extremes in his own life. According to tradition, he used a tub for shelter and walked the streets barefoot. A legend tells that he carried a lamp in broad daylight, announcing that he was "in search of a human being." Diogenes is often credited with saying that he was looking for "an honest man," but there is no reliable evidence that he ever made this statement. He held up the life of animals as a model for humanity, for he believed that good birth, riches, and honour would not help people to lead a virtuous life.

Diogenes was born at Sinope, in Asia Minor. Pirates captured him during a journey from Athens to Aegina and offered him for sale as a slave. He told his captors he knew no trade except how to govern people. Pointing to a wealthy Corinthian, he said: "Sell me to this man, he needs a master." The Corinthian bought Diogenes and made him tutor to his sons. When Alexander the Great came to see Diogenes, who was sunning himself, he said, "Ask any favour you wish." Legend says that Diogenes replied: "Please move out of my sunlight," to which Alexander commented: "If I were not Alexander, I would like to be Diogenes."

See also Cynic philosophy.

**Dionaea.** See Venus'-flytrap.

**Dionysius the Elder** (430?-367 B.C.) was a Greek tyrant and military leader who ruled in ancient Sicily for almost 40 years. He became a general at Syracuse, the largest Greek city on Sicily, in 406 B.C., during a war with Carthage. In 405 B.C., he made peace with the Carthaginians and became ruler of Syracuse. Dionysius hired many foreign soldiers, defeated armies from Carthage in 396 and 392 B.C., and extended his control over much of Sicily. He later gained control of much of southern Italy and assisted Sparta in its battles in Greece.

During the 370's B.C., the Carthaginians defeated Dionysius and forced him to give up half of Sicily. Dionysius died of fever during another war with Carthage. He was succeeded as ruler by his son Dionysius the Younger.

**Dionysus** was the god of wine in Greek mythology. After coming into contact with Greek culture, the Romans adopted Dionysus as their god of wine, but they called him Bacchus.

The ancient Greeks associated Dionysus with violent and unpredictable behaviour, especially actions caused by drinking too much wine. Most stories about Dionysus tell of his sessions of drunken merrymaking. Dionysus' followers at these gatherings included *nymphs* (maidens) and creatures called *satyrs* that were half man and half horse or goat (see *Nymph*; *Satyr*). The merrymaking ended with religious ceremonies carried out to honour Dionysus.

Dionysus' parents were Zeus, the king of the gods, and Semele, the mortal daughter of King Cadmus of Thebes. Dionysus married Ariadne, the daughter of King Minos of Crete.

Not all the stories about Dionysus concern drunkenness or violent behaviour. Many Greeks believed that Dionysus taught people farming techniques, especially those related to growing grapes and making wine. The Greeks also dedicated the great theatre in Athens to Dionysus. Their concept of tragedy in drama grew from a ceremony that honoured Dionysus. The word *tragedy* comes from the Greek word *tragos*, meaning *goat*. The goat was sacred to and symbolic of Dionysus.

See also Bacchus; Drama (Greek drama).

**Diopside** is a widely occurring mineral with a glassy lustre. Diopside is sometimes used as a gemstone (see Gem [picture]). It belongs to a group of rock-forming minerals called *pyroxenes*. Diopside is a *silicate* rich in calcium and magnesium (see *Silicate*). Its chemical formula is  $\text{CaMgSi}_2\text{O}_6$ . Pure diopside is white, and it melts at 1391°C. An impurity of iron may make the mineral light green. Diopside forms when intense heat and pressure are applied during metamorphism to limestone that consists chiefly of dolomite with silica impurities (see *Metamorphism*). Diopside also forms during the crystallization of *magma* (molten rock material).

**Dior, Christian** (1905-1957), is considered one of the great French fashion designers of the 1900's. In 1946, Dior founded his *couture house* (a company that creates fashion designs and apparel). His first collection, unveiled in 1947, was an immediate success. Dior's 1947 designs were called the *New Look* because they differed from the fashions of the early 1940's.

Dior's New Look fashions featured a luxurious use of fabric, including extravagant full skirts. The New Look also replaced padded shoulders with a natural shoulder line. Dior recognized the importance of novelty in fashion. He emphasized the overall look by carefully selecting accessories to harmonize with each design. During the 1950's, his designs extended into furs, hats, hosiery, jewellery, and perfumes. His international fashion business became a model for the organization of later fashion empires. Dior was born in Granville, France.

**Dioxin** is any of 75 related chemicals, all of which consist of carbon, chlorine, hydrogen, and oxygen. However, the word *dioxin* is most commonly used to refer to only one of these chemicals, the highly toxic compound 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (TCDD).

TCDD is a useless by-product of the manufacture of certain weedkillers and several other industrial processes. Disposal of the chemical is difficult, because it



does not readily *degrade* (break down) in soil or water. One of the most effective methods of disposing of dioxin is burning the material at high temperatures. Soil and water in parts of Canada, Europe, and the United States, however, have become contaminated with dioxin, because of improper disposal of industrial waste products.

The health effects of TCDD are not completely understood. The chemical is extremely deadly to certain animals, but no human deaths have been directly linked to it. However, some people have developed such health problems as headaches, stomachaches, and a severe skin rash called *chloracne* as a result of exposure to dioxin. Some researchers also believe the chemical may cause birth defects and cancer.

TCDD was first identified as a contaminant in 1957. It was present in *Agent Orange*, a weedkiller used by U.S. armed forces in the 1960's and early 1970's, during the Vietnam War. Dioxin was not recognized as a major public health hazard until the mid-1970's.

See also **Agent Orange**.

**Diphtheria** is a severe, contagious infection of the upper respiratory system or the skin. It can involve serious—or even fatal—complications. During the late 1800's, diphtheria epidemics swept western Europe and the United States. At that time, most victims were under 10 years of age. Today, diphtheria affects children and adults about equally. Widespread immunization with diphtheria vaccines has greatly reduced the number of cases of diphtheria.

**Cause, symptoms, and complications.** Diphtheria is caused by a bacterium called *Corynebacterium diphtheriae*. This organism commonly infects the mucous membranes of the upper breathing passages, particularly the tonsils and the *pharynx* (the back of the mouth and the upper throat). The bacteria produce a *toxin* (poison), which enters the blood and is carried throughout the body. Infected individuals spread the bacteria by coughing or sneezing. People called *carriers* may harbour the bacteria without showing any symptoms of the disease. Although carriers show no symptoms, they can spread the illness to other people.

Symptoms appear about two to five days after infection. They include a sore throat, fever, and swelling of the lymph nodes in the neck. A thick, greyish membrane forms on the surface of the tonsils and pharynx, and may even extend up into the nose or down into the windpipe and lungs. The membrane may interfere with breathing or swallowing. In severe cases, it can completely block the breathing passages.

Diphtheria toxin can affect the heart and nervous system. One severe effect is heart muscle inflammation, called *acute myocarditis*, which may result in permanent heart damage. In some cases, the toxin so weakens the heart that death occurs. Effects of nerve damage include temporary paralysis of muscles in the throat and eyes, and, most seriously, of the muscles used in breathing. Paralysis of the breathing muscles can be fatal.

Diphtheria bacteria also can infect breaks in the skin. Such infections are called *wound diphtheria* or *cutaneous diphtheria*. In most cases of wound diphtheria, a membrane does not form over the infected area. But toxins enter the bloodstream and can produce the same complications as in the respiratory infection.

**Treatment.** Doctors hospitalize diphtheria patients and give them *diphtheria antitoxin*. This substance neutralizes diphtheria toxin. If administered early enough, the antitoxin can minimize heart and nerve complications. If the membrane that forms in the throat blocks the breathing passages, a doctor may cut a temporary opening through the neck into the windpipe. Heart failure is treated with medications. If the respiratory muscles become paralysed, a machine called a *ventilator* is used to maintain the patient's breathing. Diphtheria patients also receive antibiotics, which kill the diphtheria bacteria and help control secondary infections caused by other bacteria.

**Prevention.** People can obtain *immunity* (protection) from diphtheria by using vaccines that contain *diphtheria toxoid*. This toxoid is a specially treated form of diphtheria toxin. It does not damage body tissues, but it triggers the production of disease-fighting substances called *antibodies*. Antibodies formed in response to the toxoid will attack diphtheria toxin if it enters the bloodstream.

Public health experts recommend that infants receive a series of four diphtheria immunizations. A person should get a "booster" shot of diphtheria vaccine between the ages of 4 and 6, and about every 10 years thereafter. See **Immune system**.

**Diphthong** is the sound produced by pronouncing two vowels as a single syllable. Examples are the *ou* in *out* and *oi* in *oil*. One sees how two sounds become a diphthong by pronouncing *ah* and *ee* together slowly, then more rapidly. They become the diphthong heard in *mine*, known as *long i*.

**Diplodocus** was an extremely long, slender, plant-eating dinosaur that lived about 150 million years ago in what is now the Western United States. It belonged to a group of giant, plant-eating dinosaurs known as *sauro-pods*. The first *Diplodocus* bones were found in 1877 near Morrison, Colorado. The name *Diplodocus* means *double beam* and describes the beams of bone in the underside of the animal's tail.

*Diplodocus* grew to about 27 metres long and weighed about 10 metric tons. The neck was about 8 metres long and had 15 vertebrae. The skull was relatively small, only about 60 centimetres long, with slender peglike teeth in the front of the mouth. The tail had more than 70 vertebrae and stretched about 14 metres, tapering to a whiplike end. The animal could have swung the tail to defend itself against enemies. *Diplodocus* stood about 4 metres high from the ground to the hips. The front legs were much shorter than the hind legs. The dinosaur might have been able to stand on its hind legs, using its tail for support. *Diplodocus* ate large amounts of cycad, fern, and ginkgo leaves.

See also **Dinosaur** (picture: Dinosaurs of the Jurassic Period).

**Diplomacy** is the means of conducting negotiations between nations. Some scholars today also apply the term to the strategies and tactics nations use when they negotiate. In this sense, diplomacy involves formulating the policies that nations follow to influence other nations. When diplomacy fails during a major crisis, war often occurs.

Traditionally, however, diplomacy referred to the formal practice that most nations follow of sending repre-



sentatives to live in other countries. These *diplomats* help carry on day-to-day relationships between their country and the country where they serve. They work to gain political or economic advantages for their country and to promote international cooperation. Each nation handles its diplomatic affairs through a foreign office, which is given an official name.

**Diplomatic duties.** Diplomatic officers abroad are the accredited spokespersons for their governments. They gather information on everything of value to their governments and transmit it in formal reports, usually in code (see **Codes and ciphers**). Diplomatic officers also protect the rights of fellow citizens while they are abroad.

Diplomats have their headquarters in an embassy or legation. The only difference between an embassy and a legation is the rank of the diplomat in charge. An ambassador heads an embassy, and a minister heads a legation.

**Diplomatic immunity.** Diplomats enjoy several important privileges and immunities while serving abroad. These privileges arise partly because diplomats are the direct representatives of sovereign powers. Just as important, diplomats must have complete independence of action to perform their duties. A diplomat's privileges are based on the principle of *extraterritoriality*. This principle, used in international law, includes the guarantee that people living in foreign countries remain under the authority of their own governments. Four important diplomatic privileges and immunities are:

1. Diplomats cannot be arrested for any reason. Their families usually share this exemption.
2. Their residences, papers, and effects cannot be searched or seized.
3. Their personal belongings cannot be taxed by the country in which they serve.
4. Diplomats, their families, and their staffs enjoy complete freedom of worship.

**History.** Nations have not always used diplomacy to settle international problems. The ancient Romans used diplomatic representatives only for special purposes. But as relations among countries grew more complex, many nations found that they needed permanent representatives in other countries. Embassies first appeared in Italy during the 1200's and 1300's. At that time, they served as headquarters for spies and espionage agents, as well as for diplomats. Many historians believe that Cardinal Richelieu of France started the system of resident representatives during the 1600's.

Some scholars argue that diplomatic representatives are unnecessary today because of the ease of high-level exchanges and long-distance communication. But ongoing personal diplomatic contact has many advantages. Diplomats take great care to make friends with government officials and influential citizens. When they present a formal proposal, they can count on these friendships to help them. Diplomats also can test reaction to ideas their governments are considering by talking with acquaintances.

**Related articles in *World Book* include:**

Ambassador	Extraterritoriality	Legation
Attaché	International relations	Minister
Consul		Protocol
Diplomatic corps		

**Diplomatic corps** consists of all the heads of diplomatic missions, such as ambassadors and ministers, who represent their governments in a foreign nation. The term may also refer to all the diplomatic personnel of such missions. A diplomatic mission, generally an embassy or a legation, consists of an ambassador, a minister, or a chargé d'affaires; counsellors and secretaries; and various attachés.

Diplomats conduct their government's official relations with the host government, including the negotiation of treaties. They also report to their government on economic, financial, military, and political conditions in the host country.

See also **Ambassador; Diplomacy.**

**Diplura.** See **Insect** (table: Order and common names). **Diponegoro, Pangeran** (1785-1855), was a Javanese prince who fought against the Dutch in the Java War (1825-1830). The Indonesian government has acclaimed Diponegoro as a national hero.

Diponegoro was the son of Hamengku Buwono III, the sultan of Yogyakarta, Java. In May 1825, Diponegoro's followers clashed with Javanese enemies. In July, the Dutch sent troops to arrest Diponegoro. He resisted and escaped. He and his followers rebelled against the Dutch. They were supported by other Javanese aristocrats. The rebellion lasted five years. The war cost the lives of at least 200,000 Javanese, as well as 8,000 Europeans and 7,000 Indonesians fighting on the Dutch side. In 1830, Diponegoro met the Dutch to negotiate. When no agreement was reached, the Dutch arrested Diponegoro and sent him to exile in Makassar, Indonesia, where he died.

**Dipper** is a small thrushlike bird which dives and dips under water in search of insects. The name *dipper* may come from the bird's habit of dipping or bobbing as it stands on a stone in the middle of a stream. Dippers live in mountain regions. They build mossy, domed nests above running water. Sometimes they build their nests behind a waterfall for protection. The females lay three to five white eggs.

Most dippers are brown or grey. The European dipper is distinguished by its white breast. Other dippers live in North and South America and in Asia.

**Scientific classification.** Dippers belong to the family Cinclidae.

**Diprotodon** was the largest marsupial that ever lived. Diprotodons weighed about 2 metric tons, which means that they were about the size of a rhinoceros. Diprotodons were plant eaters that lived in Australia and New Guinea. The first fossil remains of Diprotodons were part of a jawbone and a single tooth. Both pieces were discovered in 1830. Scientists realized that the animals must have had two large incisors. They gave them the name *Diprotodon*, which means *two front teeth*. Complete skeletons were found later. The greatest collection of fossil remains was found at Lake Callabonna in South Australia.



European dipper



**Diptera.** See Insect (table).

**Dirac, Paul Adrien Maurice** (1902-1984), a British theoretical physicist, became noted for his mathematical equation describing the behaviour of the electron. Dirac also demonstrated the fundamental unity of the two forms of *quantum mechanics*, wave mechanics and matrix mechanics (see **Quantum mechanics**). He shared the 1933 Nobel Prize for physics with the Austrian physicist Erwin Schrödinger for his equation and his other contributions to quantum mechanics.

Dirac introduced his equation, now called the *Dirac equation*, in 1928. It accounts theoretically for the spin of an electron and for other aspects of the particle's behaviour. Dirac's theory also correctly predicted that the negatively charged electron should have an antiparticle—a positively charged electron (see **Antimatter**).

Dirac was born in Bristol, England. He attended Bristol and Cambridge universities. From 1932 to 1969, he held the Lucasian Professorship of Mathematics at Cambridge. In 1971, Dirac became a professor of physics at Florida State University in the United States. His book *The Principles of Quantum Mechanics* (1930) is a classic in its field.

See also Anderson, Carl D.; Schrödinger, Erwin.

**Direct current.** See Electric current; Electric generator.

**Direct-mail advertising.** See Advertising (Direct mail).

**Direct primary.** See Primary election.

**Direct Selling Association (DSA)** is a trade organization of companies that sell products to consumers in their homes or work places. Products include cosmetics, household goods, appliances, food, books, water filters, toys, and clothing. About 40 countries have a national DSA. Each DSA monitors legislation that affects companies involved in direct selling.

**Dirigible.** See Airship.

**Disabled.** See Handicapped.

**Disarmament** is the elimination, reduction, or limitation of a nation's armed forces. Disarmament can usually only be achieved by international agreement. No nation has ever been persuaded to give up completely its ability to defend itself or attack enemy nations militarily. As a result, disarmament agreements are really arms control agreements.

**The arguments about disarmament.** The trend since World War II (1939-1945) for more and more countries to manufacture nuclear weapons has led to a campaign for arms control. Supporters of this campaign believe that the overwhelming power of nuclear arms is excessive. Countries with nuclear arms have enough weapons to wipe out each other several times over. No country could survive a nuclear attack. A country threatened with nuclear attack might itself attack first and cause a nuclear war. International arms control agreements reduce world tension by reducing the need for countries to acquire nuclear weapons.

Opponents of arms control believe that their country is only safe and secure if it is militarily strong. Having strong armed forces does not itself cause international tension. That is really the result of political and economic disputes. These disputes should be settled before nations enter into arms control agreements. Countries that seek arms control treaties before settling other

differences raise false hopes and encourage governments to stop funding defence programmes.

**History.** Disarmament on a significant international scale dates from the end of World War I (1914-1918). The peace treaty signed after the war disarmed Germany and limited the size of its army. In 1922, France, Italy, Japan, the United Kingdom (UK), and the United States all agreed to destroy some of their battleships and ban the building of new ones for 10 years. In 1930, Japan, the UK, and the United States also agreed to limit the size of their cruisers, destroyers, and submarines. The agreement lasted until 1936. By 1941, all the nations who were parties to these agreements were at war.

After World War II, international agreements provided for the disarming of Germany and Japan. The United Nations (UN) tried to secure an agreement limiting arms for all countries, chiefly through the Disarmament Commission, to which all UN members belonged from 1959. In that year, an international treaty was signed to keep Antarctica free of military weapons.

In 1963, the United Test Ban Treaty was signed and ratified by the United States and what was then the Soviet Union, the group of Communist states led by Russia. The United Kingdom also signed the treaty. Later, a series of treaties banned or limited military activities in many situations. They included a ban on military actions in outer space (1967), a nuclear weapons ban in Latin America (1968), and a UN-approved Treaty on the Non-proliferation of Nuclear Weapons (1970). The UN also approved a Seabed Arms Control Treaty (1972), to set limits to the placing of nuclear weapons on the ocean floor, and a Biological Weapons Convention (1975). In 1972, the United States and the Soviet Union signed two agreements. One was to control each other's defensive missile strength. The other was to restrict the production of certain types of *strategic* (long-range offensive) nuclear weapons.

Beginning in the late 1980's, improved U.S.-Soviet relations led to a number of arms-control agreements. In 1988, a U.S.-Soviet treaty went into effect that eliminated all of the two countries' ground-launched nuclear missiles with ranges of 500 to 5,500 kilometres. The treaty also provided for the first inspection procedures on national territory to support verification.

In 1990, the United States and the Soviet Union, along with 20 other nations, signed a treaty to destroy large numbers of their tanks and other nonnuclear weapons in Europe. This agreement, called The Conventional Forces in Europe Treaty, went into effect in 1992. In July 1991, President George Bush of the United States and Soviet President Mikhail Gorbachev signed the Strategic Arms Reduction Treaty, or START. This treaty, now known as START I, was designed to reduce U.S. and Soviet long-range nuclear missiles and bombers by about a third. Final approval required legislative ratification by both countries. Later in 1991, the United States and the Soviet Union announced they would take out of service most of their short-range nuclear weapons and destroy many of them.

The future of START I and many other arms-control agreements became uncertain when the Soviet Union was dissolved in late 1991. This event raised questions about who would be responsible for ratifying and carrying out agreements entered into by the Soviet Union. In



1992, however, officials of Belarus, Kazakhstan, Russia, and Ukraine—the four former Soviet states that possessed nuclear weapons—signed an agreement upholding START I. The agreement also committed Belarus, Kazakhstan, and Ukraine to eliminating their nuclear weapons. The United States and the four former Soviet states ratified the agreement. In 1994, the agreement went into effect.

In 1993, Bush and Russian President Boris Yeltsin signed START II, a treaty to supplement START I. START II would cut the number of U.S. and former Soviet long-range nuclear weapons to less than half the number proposed by START I. To go into effect, START II required ratification by both countries' legislatures and implementation of START I.

In 1993, 125 countries signed a UN-sponsored treaty banning the manufacture, use, transfer, and stockpiling of chemical weapons. The treaty required ratification by 65 countries. By the mid-1990's, only a few countries had ratified the treaty.

See also **United Nations (Arms control); Strategic Arms Reduction Treaty.**

**Disaster** is a sudden event that has very unfortunate consequences for those affected by it. Disasters involve large-scale loss of life and property. The worst disasters in history have killed thousands of people at a time. Some have destroyed whole towns or cities. A volcanic explosion on the island of Thera (now Santorini) about

1500 B.C. wiped out the entire Minoan civilization on the island of Crete, 120 kilometres away.

Disasters are of two types: (1) *natural disasters*, usually caused by geological or meteorological events, and (2) *major accidents* involving human actions or technology. Famine, drought, and war are regarded as disasters, but their onset is usually rather gradual. This article deals with sudden events.

**Natural disasters** have usually been far more destructive of life and property than have accidents resulting from human actions. This is because most natural events, such as volcanic eruptions, cyclones, hurricanes and floods, unleash massive forces that humans are rarely able to match.

Historically, earthquakes have been the most damaging natural disasters. They have brought great loss of life and made millions of people homeless. They usually strike without warning, and efforts to predict them continue to prove fruitless. Falling objects and collapsing buildings cause most deaths and injuries during an earthquake. Perhaps the worst quake ever recorded was that of 1201, centred on northern Egypt or Syria. It killed more than 1 million people.

Earthquakes that take place in or near the sea are usually associated with a destructive tidal wave, or *tsunami*. In 1992, an earthquake near Maumere on the island of Flores, Indonesia, triggered tsunamis that devastated the coast of Flores and killed about 2,500 people.

## Major disasters

Year	Location	Dead	Type of disaster	Year	Location	Dead	Type of disaster
64	Rome	Unknown	City fire	1927	Central China	200,000	Earthquake
365	Crete	50,000	Earthquake	1932	Central China	70,000	Earthquake
856	Iran	200,000	Earthquake	1935	Western India (now Pakistan)	60,000	Earthquake
893	India; Iran	330,000	Earthquake	1939	Central Chile	30,000	Earthquake
1138	Egypt; Syria	330,000	Earthquake	1960	Western Morocco	12,000	Earthquake
1201	Northern Egypt	1,100,000	Earthquake	1962	Northwestern Iran	10,000	Earthquake
1268	Cilicia (now Turkey)	60,000	Earthquake	1963	Cuba; Haiti	6,700	Hurricane (Flora)
1290	Northeastern China	100,000	Earthquake	1968	Northeastern Iran	11,588	Earthquake
1556	Central China	830,000	Earthquake	1970	Western Peru	66,794	Earthquake; landslide
1667	Caucasus (now Azerbaijan)	80,000	Earthquake	1970	East Pakistan (now Bangladesh)	266,000	Cyclone; tsunami
1669	Sicily	20,000	Mount Etna eruption	1972	Nicaragua	5,000	Earthquake
1693	Sicily	100,000	Earthquake	1974	Kashmir	5,200	Earthquake
1703	Honshu, Japan	200,000	Earthquake	1976	Guatemala	23,000	Earthquake
1730	Hokkaido, Japan	137,000	Earthquake	1976	Northeastern China	240,000	Earthquake
1731	Beijing, China	100,000	Earthquake	1977	Canary Islands	583	Aeroplane collision
1737	Calcutta, India	300,000	Earthquake; tornado	1977	Southern India	15,000	Cyclone; tsunami
1755	Lisbon, Portugal	60,000	Earthquake	1977	Eastern Iran	15,000	Earthquake
1779	Northern Iran	100,000	Earthquake	1978	West Indies	2,068	Hurricane (David)
1783	Southern Italy	50,000	Earthquake	1979	Northern Algeria	5,000	Earthquake
1815	Sumbawa, Indonesia	92,000	Mount Tambora eruption	1980	Bhopal, India	2,800	Poisonous gas leak
1865	Mississippi River, U.S.A.	1,653	Ship explosion	1985	Southern Bangladesh	10,000	Cyclone; tsunami
1868	Ecuador	70,000	Earthquake	1984	Central Japan	520	Aeroplane crash
1883	Southwestern Indonesia	36,000	Krakatau eruption; tsunamis	1985	Central Mexico	7,200	Two earthquakes
1887	Eastern China	900,000	Huang He R. flood	1985	Western Colombia	25,000	Nevado del Ruiz eruption; mudslide
1889	Johnstown, U.S.A.	2,200	Burst dam; flood	1987	Ecuador	5,000	Earthquake; landslide
1900	Galveston, U.S.A.	6,000	Hurricane; storm tide	1987	Mindoro Strait, Philippines	1,840	Ship collision; fire
1902	Martinique	38,000	Mont Pélee eruption	1988	Armenia	25,000	Earthquake
1906	San Francisco, U.S.A.	3,000	Earthquake; fire	1990	Northwestern Iran	40,000	Earthquake
1908	Sicily	75,000	Earthquake	1991	Southern Bangladesh	138,000	Cyclone; tsunami
1912	North Atlantic	1,500	Sinking of <i>Titanic</i>	1991	Cairo, Egypt	543	Earthquake
1915	Central Italy	29,970	Earthquake	1992	Flores, Indonesia	2,500	Tsunami
1917	Halifax, Canada	1,635	Ship explosion	1992	Haiti	275	Ferry sinking
1920	Central China	200,000	Earthquake	1993	Maharashtra, India	9,748	Earthquake
1923	Tokyo-Yokohama	142,800	Earthquake; fire	1994	Utö, Finland	912	Ferry sinking



Erupting volcanoes, floods, cyclones, and hurricanes cause fewer deaths today than they once did because modern technology allows experts to warn people beforehand. Towns and villages in the path of a lava flow or a violent storm can usually be evacuated quickly and successfully. These occurrences do, however, cause massive damage and destruction to buildings and agricultural land, especially in developing countries.

The most dramatic volcanic eruptions, such as the eruption of Mount Vesuvius in A.D. 79, have been totally unexpected events. Before 79, Vesuvius had not erupted for centuries. The worst volcanic eruption in modern history was that of Mount Tambora on the island of Sumbawa, Indonesia, in 1815. In a catastrophic explosion, the 4,000-metre Mount Tambora blew off about one-third of its height. The blast killed more than 90,000 people and made thousands more homeless. The eruption hurled debris into the atmosphere and darkened the skies around the world for months. The year 1816 became known as "the year without a summer."

Floods can cause destruction over a wide area. In 1887, during what was probably the worst flood in recorded history, the Huang He River in eastern China overflowed an area of 130,000 square kilometres and killed about 900,000 people. The worst cyclone ever recorded struck East Pakistan (now Bangladesh) in 1970. Cyclones are common in this region, but the 1970 one was exceptionally destructive. It killed more than a quarter of a million people, left millions homeless, and swamped precious agricultural land.

**Accidents** involving human actions or technology include air crashes, ship collisions and sinkings, train crashes, and fires. They rarely cause as many deaths as natural disasters but they can be just as destructive of property. The great fire of London in 1666 razed most of the old city of London to the ground but caused the deaths of only six people. In 1989, the oil spill caused by the oil tanker *Exxon Valdez* in Alaska, U.S.A., fouled 1,600 kilometres of coastline, including beaches in wildlife reserves. The accident caused no human casualties but killed thousands of birds and other animals.

There are many accidents in history that have cost large numbers of lives. The release in 1984 of poisoned gas from a factory in Bhopal, India, killed 3,500 people. The sinking of the *Titanic* in the North Atlantic in 1912 drowned about 1,500 people. The worst accident at sea

in modern times was a collision in 1987 between a passenger ferry and an oil tanker in the Mindoro Strait in the Philippines. About 1,840 people died in the tragedy. About 800 people died in the worst train crash in history, which occurred in 1981 in Bihar, India.

The worst air crash occurred in Japan in 1985 when a Boeing 747 jumbo jet airliner plunged into Mount Okura killing 520 passengers and crew. The worst collision between aircraft occurred on the ground in 1977 between two 747s taxiing along intersecting runways at Tenerife airport in the Canary Islands. The accident killed 583 people aboard the two aircraft. Space exploration has included a few disasters in both the U.S. and former Soviet space programmes. In one of the worst, seven U.S. astronauts died in 1986 when the Space Shuttle *Challenger* blew up just after liftoff.

Some major disasters are in the table with this article.

**Related articles in World Book include:**

Earthquake	Flood	Tornado
Cyclone	Tidal wave	Volcano (table)

**Disciple.** See Apostles.

**Discovery.** See Exploration; Invention.

**Discrimination.** See Segregation.

**Discus throw** is one of the oldest individual sports. It was a popular event with the ancient Greeks in their Olympic Games. The Greeks considered the discus-throwing champion the greatest athlete.

Athletes throw the discus from a circle 2.5 metres in diameter. The discus thrower holds the discus in the palm of one hand, the ends of the fingers curling around the rim. He or she whirls in a complete turn to gather speed and power, and hurls the discus at the end of another half turn. The fingertips spin the discus as it leaves the athlete's hand, and the discus flies through the air in a fairly flat position.

A throw does not count if the thrower steps on the circle or touches the ground outside the circle before the discus strikes the ground. Judges measure the throw from the inside edge of the circle to the nearest point the discus struck the ground. Under international rules, each athlete gets six throws if eight or fewer contestants enter the competition. If more than eight athletes compete, each one gets three throws. The eight with the longest throws qualify for the finals, where each of the eight gets three more throws.

See also Athletics; Olympic Games.

### How to throw a discus

The discus thrower stands in a circle measuring 2.5 metres in diameter. He must not step outside this circle. He holds the discus flat against the palm of his hand, and swings within the circle with his arm outstretched. He releases the discus at the end of  $1\frac{1}{2}$  turns. The power comes from his body and the follow-through of his arm.







**Diseases may be either infectious or noninfectious.** The child in the picture on the left has chickenpox, an infectious disease. Infectious diseases are caused by germs that invade the body. The photograph on the right shows a patient being treated for a noninfectious kidney disease.

## Disease

**Disease** is a sickness of the body or the mind. A disease can be as mild as a sore throat or as serious as a heart attack. Diseases can strike almost any part of the body. They can also affect a person's mental and emotional health. This article discusses mainly diseases of the body. For information on mental and emotional diseases, see the article **Mental illness**.

Diseases have killed or disabled more people than all the wars ever fought. Each year, tens of millions of people die from diseases. Millions more survive serious diseases, such as cancer or strokes, but may be left permanently disabled. Countless others have mild diseases, such as colds or earaches, and recover.

Many diseases are caused by tiny living things, such as *bacteria* or *viruses*, that invade the body. These tiny objects are commonly called *germs*, but scientists refer to them as *microorganisms*. The diseases caused by these objects are called *infectious diseases*.

All other diseases can be grouped together as *noninfectious diseases*. Noninfectious diseases have many causes. Some are caused by substances that harm or irritate the body, such as cigarette smoke or traffic fumes. Others result from not eating a balanced diet. Worry and tension can lead to headaches, high blood pressure, and other illnesses. Still other noninfectious dis-

eases occur simply because aging affects some of the body's parts.

Nearly everyone becomes ill at one time or another. But not everyone is equally likely to get a particular disease. For example, most cases of mumps and chickenpox occur in children. These diseases normally can attack only once. Because most people catch these illnesses as children, they are protected from them as adults. On the other hand, adults are more likely to develop conditions such as arthritis, heart disease, and other illnesses that involve the gradual breakdown of the body's tissues.

Some illnesses occur chiefly in certain climates and geographical regions. African sleeping sickness, for example, is found mainly in very hot, humid regions of Africa. This disease is caused by a microorganism carried by an insect called the *tsetse fly*, which lives in such areas. Similarly, people who make their home near swamps are more likely to get malaria than people who live farther from such wet areas. Certain kinds of mosquitoes spread malaria, and swamps serve as breeding grounds for the insects.

Other diseases strike mainly during certain seasons. Most cases of influenza, for instance, occur in winter. Influenza is caused by a virus that spreads directly from one person to another. During cold weather, the crowding of people indoors probably helps the virus to spread more easily.



Diseases have troubled human beings throughout history. Medical researchers have examined the remains of Egyptian mummies more than 2,000 years old. They have discovered that the ancient Egyptians suffered from many of the same kinds of diseases as we do.

However, diseases do change over time. In many countries, important changes have been brought about by improved living standards and advances in medical science. An improved standard of living helps to provide good food and clean homes. It also enables them to take better care of their health. Advances in medical science make it possible to prevent and treat many diseases that once caused death.

As recently as 1900, such infectious diseases as poliomyelitis and typhoid fever were major killers in Australia, Canada, northern Europe, and the United States. These diseases cause few deaths in those countries

today. Heart disease, cancer, and other noninfectious diseases are now the chief causes of death.

### Infectious diseases

Infections are the most common type of disease. Many kinds of bacteria, viruses, and other microorganisms can invade the human body and cause disease. Disease-causing microorganisms are called *pathogens*. Pathogens take over some of the body's cells and tissues and use them for their own growth and reproduction. In the process, they damage or destroy the cells and tissues and so produce diseases.

Infectious diseases can be grouped according to the kind of pathogen that causes them. Bacteria and viruses are the most common pathogens. But fungi, protozoans, and worms also can cause infectious diseases.

**Bacterial diseases.** Bacteria are microscopic, single-

### Some communicable diseases

Disease	Symptoms	Incubation period*	Period of communicability	Preventive measures
<b>AIDS</b>	Opportunistic illnesses (disorders that usually do not occur when the immune system functions properly).	Averages 8 to 11 years. Specific cases vary widely.	Immediately after infection and as long as virus remains in body.	Avoid sexual contact with infected individuals. Avoid sharing hypodermic needles.
<b>Chickenpox</b>	Small blisters that form crusts, fever, headache, general discomfort.	11 to 20 days.	From 1 to 2 days before symptoms appear until 6 days after first rashes form.	None. Getting the illness gives permanent immunity.
<b>Chlamydia</b>	In men, painful urination and discharge from the penis. In some women, vaginal discharge. Many women have no symptoms. In infants, causes pneumonia or conjunctivitis.	In adults, 1 to 3 weeks. In infants, conjunctivitis may develop in the first 10 days of life. Pneumonia may develop 3 to 6 weeks after birth.	In adults, about 16 months. Unknown for infants.	Avoid sexual contact with infected individuals.
<b>Influenza</b>	Fever, chills, muscular aches and pains.	1 to 5 days.	When symptoms appear until 7 days after.	Influenza immunization protects for only a few months.
<b>Measles</b>	Fever, runny nose, cough, red and watery eyes, rash.	8 to 12 days.	From 4 days before rash appears until 5 days after.	Measles immunization at 15 months of age and repeated during childhood or adolescence.
<b>Mononucleosis</b>	Sore throat, enlarged lymph glands, fatigue.	4 to 6 weeks.	Unknown.	None.
<b>Mumps</b>	Chills, headache, fever, swollen glands in neck and throat.	12 to 25 days, usually 18 days.	From 7 days before until 9 days after symptoms, or until swelling disappears.	Mumps immunization. Gamma globulin protects after exposure.
<b>Poliomyelitis</b>	Fever, sore throat, muscle pain, stiff back, paralysis.	Paralytic, 7 to 14 days. Non-paralytic, 4 to 10 days.	Last part of incubation period and first week of acute illness.	Oral poliomyelitis vaccine given at 2 months of age and repeated throughout childhood.
<b>Rubella</b>	Headache, enlarged lymph nodes, cough, sore throat, rash.	14 to 21 days, usually 18 days.	From about 7 days before rash appears until about 5 days after.	Rubella immunization. Getting the illness gives permanent immunity.
<b>Scarlet fever</b>	Sore throat, rash, high fever, chills.	A few days to a few weeks.	Beginning of incubation period until 2 or 3 weeks after symptoms appear.	None. Getting the illness usually gives permanent immunity.
<b>Syphilis</b>	Chancre sore, usually on sex organs; followed in a week to 6 months by a rash.	10 days to 3 months, usually 3 weeks.	Variable and indefinite during 2 to 4 years after infection.	Avoid sexual contact with infected individuals.

\*Incubation period refers to how long it takes for the first symptoms to appear after infection. Each of the diseases listed on this table has a separate article in *World Book*.



celled organisms. They rank among the most widespread of all living things. A single grain of soil may contain more than 100 million bacteria.

Most bacteria do not cause diseases. Many kinds of bacteria live harmlessly in the human mouth and intestines and on the skin. These "resident" bacteria seldom cause illnesses unless they move to an organ where they are not normally present. For example, bacteria that live harmlessly in the mouth can cause infections if they enter the middle ear. However, most bacterial diseases are caused by microorganisms that are not normally present in the body.

Most bacterial diseases result when bacteria multiply rapidly in living tissue, damaging or killing it. Boils and carbuncles result from the multiplication of bacteria in the skin. Bacterial pneumonia occurs when bacteria invade the lungs and multiply there. Many other serious diseases, including gonorrhoea and tuberculosis, result from bacterial multiplication.

Other bacteria cause disease by producing *toxins* (poisons). For example, tetanus, also called lockjaw, is a disease that begins after bacteria that normally live in soil enter the body through a wound. The bacteria produce a poison that affects muscles and nerves far away from the wound. Food poisoning results from eating foods that contain certain bacterial toxins. Botulism, a kind of food poisoning, involves one of the most deadly toxins known. Botulinus toxin is produced by bacteria called *Clostridium botulinum*. See **Bacteria**.

**Viral diseases.** Viruses are smaller than bacteria. They are so tiny that scientists can see them only by means of powerful electron microscopes. By itself, a virus seems to be a lifeless particle. But after a virus invades a living cell, it uses materials in the cell to reproduce. As a virus multiplies, it damages or destroys the cell. If a number of cells become infected, a disease results.

Viruses cause many common diseases, including chickenpox, rubella, measles, and mumps. Viruses are also responsible for influenza and the common cold. In fact, scientists have identified more than 100 different viruses that cause the common cold. Most cases of diarrhoea and vomiting result from viral infections. Viruses also cause many serious diseases, including AIDS (Acquired Immune Deficiency Syndrome), hepatitis, polio, and rabies. The virus that causes AIDS destroys the immune system's ability to function properly. As a result, people infected with the virus become susceptible to certain illnesses that do not normally occur or that normally are not serious. Many people with AIDS die from these illnesses. See **AIDS**; **Virus**.

**Other infectious diseases** can be caused by fungi, protozoans, and worms that live in or on the human body. These pathogens obtain food by breaking down body tissues or by absorbing digested food from the intestines. They produce diseases ranging from minor skin infections to life-threatening internal disorders.

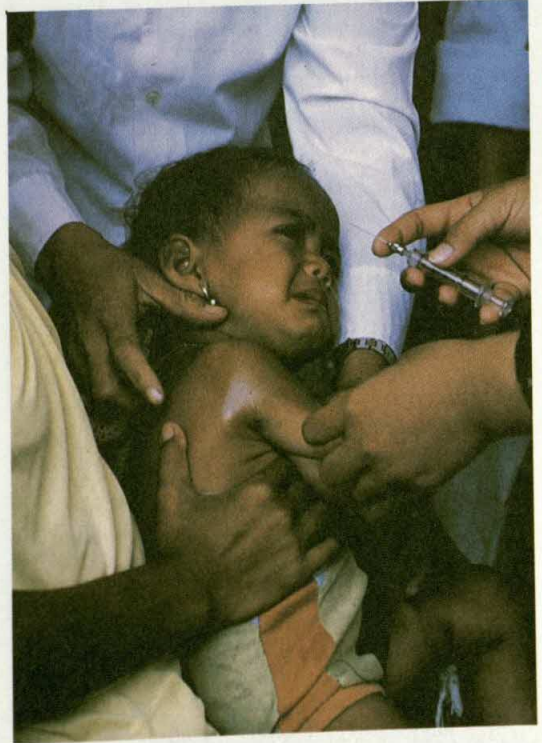
Fungi resemble green plants but cannot make their own food. Some of the best-known fungi include moulds and mushrooms. A few kinds of fungi live on the human skin, where they cause athlete's foot, ringworm, and other infections. Disease-producing fungi also can cause brain inflammations and a lung disease called histoplasmosis. See **Fungi**; **Fungal disease**.

Protozoans are single-celled animals. Disease-producing protozoans are found chiefly in tropical areas. They cause such diseases as amoebic dysentery, an intestinal infection; malaria; and African sleeping sickness.

Certain flatworms and roundworms cause human diseases. Disease-producing flatworms include flukes, which can invade the blood, intestines, liver, or lungs; and tapeworms, which live in the intestines. Disease-producing roundworms include hookworms and pinworms, which live in the intestines; trichinal worms, which infect the muscles; and filarial worms, which invade the fluids beneath the skin. Worm infections cause many serious tropical diseases, including elephantiasis, river blindness, and schistosomiasis.

**Spread of infectious diseases.** Most infectious diseases are *communicable*—that is, they can spread from person to person. Occasionally, an infectious disease becomes highly contagious and sweeps through a community. This condition is called an *epidemic*. When an epidemic occurs at several places throughout the world at the same time, it is called a *pandemic*. Such an outbreak took place during the winter of 1918-1919, when influenza swept the world, killing about 20 million people.

Some infectious diseases are always present in a particular geographical region. Such diseases are said to be *endemic* in that region. For example, malaria is endemic throughout much of Africa.

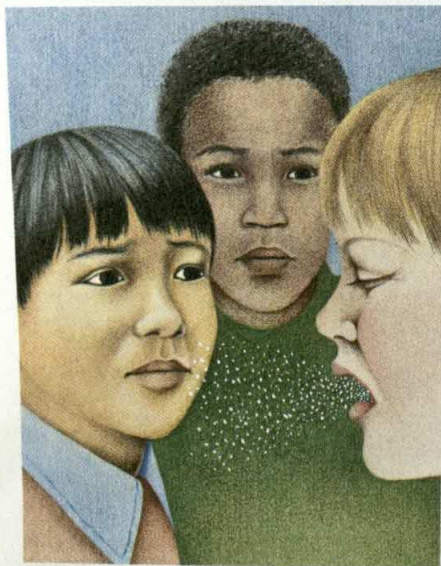


**Diseases** can disable or kill young children. By using drugs such as antibiotics, doctors can treat or even prevent serious illness and save many millions of lives each year.



## How infectious diseases spread

Most infectious diseases are *communicable*—that is, they can spread from one person to another. Disease-causing microorganisms, called *pathogens*, are spread in three chief ways: (1) by people, (2) by animals, especially insects, and (3) by nonliving sources.



**A sick person** can spread pathogens in the tiny droplets released in coughs and sneezes. Diseases spread this way include colds and influenza.



**Mosquitoes** spread germs that cause encephalitis, malaria, and yellow fever.



**Nonliving objects**, such as the spout on a public drinking fountain, may carry germs left by a sick individual.

Infectious diseases can be spread in three chief ways. They are (1) by people, (2) by animals, and (3) by nonliving sources.

**By people.** Many common infectious diseases spread as a result of close contact with a sick person. Such contact frequently takes place through coughing or sneezing, which expels tiny droplets of moisture that may contain pathogens. If people breathe in these droplets, the pathogens can spread from the sick person to healthy people. Diseases that spread largely through coughing and sneezing include colds, influenza, measles, mumps, pneumonia, tuberculosis, and whooping cough.

Some diseases are transmitted when a healthy person comes into direct contact with an infected area on another person's body. Certain skin infections, such as boils and impetigo, spread this way. So do sexually transmitted diseases, which are spread by sexual contact with an infected person (see **Sexually transmitted disease**).

For most communicable diseases, an infected person is contagious only during part of the illness. This *period of communicability* can range from a few days to months or even years. For example, the period of communicability for chickenpox is about one week—from a day or two before the rash breaks out until the day the last sore crusts over. But the period of communicability for gonorrhoea lasts as long as the person has the bacteria within his or her body.

Some people carry infectious organisms within their body but do not show any sign of illness themselves. Many cases of diphtheria, gonorrhoea, pneumonia, and typhoid fever result from contact with such *carriers*. The

identification and treatment of carriers plays an important role in the control of these diseases.

**By animals.** Insects spread some of the most deadly infectious diseases. Fleas, mosquitoes, and other insects that feed on blood transmit many serious diseases. These blood-sucking creatures spread infection in a complex way. When such an insect feeds on an infected person or animal, it may at the same time take certain disease-causing microorganisms into its body. The pathogens develop further within the body of the insect. The infection then spreads if the insect bites a healthy person and injects some of the pathogens into the bite wound. Mosquitoes transmit encephalitis, malaria, and yellow fever in this way. In the same manner, fleas spread plague, and lice carry typhus. Ticks, which are blood-feeding animals closely related to the insects, transmit tick typhus and Lyme disease in this way.

A few infectious diseases are transmitted by direct contact with infected mammals and birds. Rabies, which is transmitted by the bite of an infected mammal, is probably the best-known example. People catch tularemia, or rabbit fever, by handling infected rabbits and squirrels. Similarly, psittacosis, also called parrot fever, spreads to human beings through direct contact with infected birds.

**By nonliving sources.** Some pathogens can survive for long periods on nonliving objects. These microorganisms can be transmitted by clothing, bedding, cutlery, and other objects handled by sick people. Certain bacterial infections sometimes spread to hospital patients through contact with such contaminated objects.

Some infectious diseases spread through drinking water. For example, mass outbreaks of diarrhoea can



occur if untreated sewage gets into a community's drinking water. In areas with poor sanitation, impure drinking water may carry pathogens that cause cholera and typhoid fever.

Contaminated foods also transmit infectious diseases. As was previously mentioned, foods contaminated with bacterial toxins can cause food poisoning. In addition, undercooked pork may contain worms that cause trichinosis. Raw cow's milk may contain bacteria that produce bovine tuberculosis and undulant fever in people. Pasteurization, a process that kills bacteria in milk, has made these two diseases uncommon in most industrial countries.

### Noninfectious diseases

Noninfectious disease is a broad term that groups together all illnesses not caused by pathogens. It includes diseases caused by the breakdown of tissues and organs, by birth defects, by poor diet, by environmental and occupational hazards, and by stress and tension.

**Chronic, degenerative diseases** are long-term disorders that involve the gradual breakdown of tissues and organs. Such diseases affect more adults than children. Included among the common chronic, degenerative diseases are cardiovascular diseases and arthritis.

**Cardiovascular diseases** affect the heart and blood vessels. These diseases, which include atherosclerosis, high blood pressure, heart attacks, and strokes, are the leading causes of death in the Western world.

Atherosclerosis is a form of arteriosclerosis, a disease of the arteries. It occurs when fatty deposits build up on the inside walls of the arteries, making the vessels hard and narrow. This condition interferes with the flow of blood through the arteries, and can lead to heart attacks and strokes. Hypertension, or high blood pressure, is another disease that contributes to strokes and heart attacks. Doctors often call hypertension "the silent killer," because it seldom produces symptoms until after it has caused widespread damage to the heart and blood vessels. Most cases of hypertension have unknown causes. See **Arteriosclerosis; Hypertension**.

A heart attack takes place when the heart does not receive enough oxygen-rich blood. It usually occurs as the result of a blocked artery to the heart. The lack of oxygen causes part of the heart muscle to die. If a large part of the heart is affected, the victim may die immediately, or within the next several weeks. Most heart attacks that affect a smaller portion of the heart are not fatal, and most patients are encouraged to begin a rehabilitation programme that includes a proper diet and a gradual increase in exercise. See **Heart (Heart attack)**.

A stroke occurs if part of the brain does not receive an adequate supply of blood. The affected portion of the brain is deprived of oxygen and nutrients, and is permanently damaged. A massive stroke can be fatal. Smaller strokes can leave the victim with various disabilities, depending on what part of the brain is affected. Common problems include paralysis and loss of speech. In some patients, undamaged areas of the brain eventually take over some of the lost functions. However, many victims of a stroke are left with permanent disabilities. See **Stroke**.

**Arthritis** is a general term for diseases that affect the joints. The most widespread forms of arthritis are rheu-

matoid arthritis and osteoarthritis. Rheumatoid arthritis causes pain and swelling in many joints throughout the body. It can lead to deformity and crippling. Rheumatoid arthritis strikes people of all ages, but it is most common among middle-aged adults. The cause of the disease is unknown. Osteoarthritis is basically a disease of older adults. It results from wear and tear on the joints, especially those of the knees, hips, and fingers. Osteoarthritis seldom causes crippling. However, the pain forces many victims to limit their activities. See **Arthritis**.

**Cancer** occurs when certain cells of the body multiply without control. It can affect any type of cell. The cancer cells eventually destroy the surrounding normal cells. In addition, these cells can spread to cells in other parts of the body. If left untreated, most kinds of cancer are fatal.

Scientists do not know exactly how normal cells are transformed into cancer cells. However, researchers have discovered that many cases of cancer occur after a person has had frequent or extended contact with various chemicals or radiation. See **Cancer**.

**Hormonal diseases** occur if the endocrine glands do not function correctly. These glands produce *hormones*, powerful chemical substances that regulate many body functions. See **Gland; Hormone**.

Perhaps the best-known hormonal disease is diabetes mellitus. It can develop if the pancreas does not work properly. The pancreas produces insulin, a hormone that enables the body to use sugar. Sugar is one of the main products of digestion. If the cells cannot use sugar, the body begins to break down its own tissues for food. Diabetes mellitus leads to death if left untreated.

Addison's disease occurs when the adrenal glands fail to produce sufficient hormones. This disease results in



**Rheumatoid arthritis**, a painful disorder of the joints, ranks as one of the most common *chronic, degenerative diseases*. Such diseases involve the gradual breakdown of tissues or organs. The X ray above shows the hand of a rheumatoid arthritis victim.



loss of weight, low blood pressure, weakness, and, eventually, death. Another endocrine gland, the thyroid, releases hormones that affect the rate at which the body uses food and builds new tissues. If this gland does not produce enough hormones during infancy, a condition known as cretinism results. Cretinism leads to poor physical growth and mental retardation. A thyroid gland that produces an excess of hormones causes hyperthyroidism. Symptoms of this condition include weight loss, sweating, and nervousness.

Various disorders, including gigantism and dwarfism, can occur if the pituitary gland and the hypothalamus, a part of the brain, do not function properly. These endocrine structures produce many hormones.

**Congenital diseases** are disorders that are present at birth. About 2 per cent of all babies are born with serious diseases. In some cases, the disease develops from an infection the mother suffered during pregnancy. For example, if the mother had German measles, the baby may be born with heart defects, mental retardation, or other disorders. Other congenital problems can occur if the mother is exposed to radiation or to certain drugs or other chemicals during pregnancy.

Many serious congenital diseases involve defects that are inherited from one or both parents. Such inherited diseases include haemophilia and sickle cell anaemia, which affect the blood; and galactosaemia and phenylketonuria (PKU), disorders in which the body cannot properly use certain foods. Most congenital diseases are apparent at birth or in early infancy. Huntington's disease, which affects the nervous system, is an example of an inherited disease that does not produce symptoms until later in life.

Certain other diseases, including hypertension and diabetes mellitus, often run in families. People whose parents have such diseases are much more likely to develop these ailments than people whose parents are free of the disorders.

**Environmental and occupational diseases.** Many environmental factors can produce serious diseases. Air pollution from factories and traffic can irritate the eyes and nose. It can also contribute to emphysema, bronchitis, and other lung diseases. Wastes from factories and chemical fertilizers from farmlands pollute many waterways. Drinking such polluted water can lead to serious illnesses. Continued exposure to loud noises from machinery, traffic, and aeroplanes can result in hearing loss. Such "noise pollution" also causes tensions that contribute to psychosomatic diseases, which are discussed later in this article.

In addition to pollutants, some of the chemicals used in modern products have been linked to diseases. For example, researchers have discovered that certain flavourings and dyes once used in packaged foods could lead to various kinds of cancers.

Exposure to some harmful environmental agents results from an individual's own habits. For example, heavy cigarette smokers expose themselves to substances that have been linked to the development of cancer, emphysema, and heart disease. Similarly, the excessive use of alcohol can lead to severe liver and brain damage. The abuse of other drugs—including sedatives, stimulants, and narcotics—also results in many serious physical and emotional diseases. See **Drug abuse**.

Some occupations expose workers to harmful environmental agents. Coal miners and workers in the asbestos, iron, and textile industries may breathe in dust that can lead to lung diseases. People who work in chemical plants risk exposure to poisonous substances. Similarly, farmers frequently handle weed- and insect-killing chemicals. These chemicals can cause serious illnesses if they are inhaled or swallowed, or even if they settle on the skin. Radiation poses a threat to X-ray technicians and to people who work with nuclear materials. Exposure to radiation increases the risk of cancer and can damage the hereditary material of cells.

**Nutritional diseases** are caused by an improper diet. In many developing countries, poverty forces people to live on an inadequate diet. Undernutrition and deficiency diseases are common among such people. Undernutrition results from an overall lack of food. It is characterized by poor growth, lack of energy, and lowered resistance to infections. Deficiency diseases result from a diet lacking in one or more essential food elements. Protein deficiency leads to kwashiorkor, a serious disease that generally strikes children and can be fatal. Vitamin deficiencies produce such diseases as beriberi, pellagra, rickets, and scurvy. Anaemia and goitre result from mineral deficiencies. See **Nutrition** (Results of malnutrition).

Improper eating habits can lead to deficiency diseases in industrialized countries as well. But in industrialized countries, the most common nutritional problems result from overeating. *Obesity* (extreme fatness) occurs when a person eats more food than the body burns up. Obesity can contribute to a variety of ailments, including cardiovascular diseases and diabetes mellitus. See **Weight control**.

**Immunological diseases** occur when the *immune system* fails to function properly. The immune system is one of the body's chief defences against disease. The immune system recognizes and attacks pathogens, cancer cells, and other foreign substances that may be present. For information on the proper functioning of the immune system, see the section *How the body fights disease* in this article.

Allergies, including asthma, hay fever, and hives, are the most common kind of immunological diseases. An allergy may occur if the immune system becomes unduly sensitive to a foreign substance. Many people develop allergies to pollen, house dust, animal hair, or various foods. When an allergic person comes into contact with such substances, the immune system overreacts. Allergic reactions can range from a runny nose and itching eyes and throat for hay fever victims to fatal reactions for people allergic to penicillin or other drugs. See **Allergy**.

Some children are born with a defective immune system. They suffer from repeated, serious infections and may live only a few years unless they receive special drugs, surgical treatment, or bone marrow transplants.

Certain serious diseases involve *autoimmune reactions*. Autoimmunity means *self-immunity*, and an autoimmune reaction takes place when the immune system attacks the body's own tissues. In a disease called systemic lupus erythematosus, the immune system attacks the skin and joints and, in severe cases, the kidneys and nervous system. Some doctors suspect that



rheumatoid arthritis and multiple sclerosis, a disease of the nervous system, also involve autoimmune reactions.

**Psychosomatic diseases** are physical disorders that result from mental stress and tension. Pressures from work or school, financial burdens, and emotional conflicts are among the many situations that can produce stress. Some people handle stress by "talking out" their problems with other people. Others learn to relieve tensions through relaxation or even by crying. But some people keep tensions bottled up inside, and this unrelieved stress can lead eventually to physical illnesses. Common psychosomatic ailments include tension headaches, pains in the chest or in the arms and legs, and stomach upsets and ulcers. In addition, unrelieved stress lowers the body's resistance to infections and other diseases. See **Stress**.

### How the body fights disease

Medical scientists have learned a great deal about how the body defends itself against illness, especially how it protects itself from infections. They have discovered that the body uses three chief kinds of defences: (1) barriers against pathogens, (2) general reactions to infection, and (3) reactions of the immune system.

**Barriers.** Unbroken skin provides an extremely effective barrier against pathogens. Similarly, few pathogens can penetrate the membranes that line the mouth and nose. These membranes are covered with *mucus*, a sticky fluid that traps many of the pathogens. The body then expels the microorganisms by sneezing or coughing. Mucous membranes also line the tubes that lead to the lungs. Tiny, hairlike *cilia* push mucus from the lungs and *trachea* (windpipe) up to the mouth. There, the mucus and its trapped germs are harmlessly swallowed.

The body also has chemical barriers against infection. Tears, for example, not only wash foreign substances from the eyes, but they also contain enzymes that destroy many common pathogens. The mucous membranes also release protective chemicals. The digestive juices of the stomach, which are rich in acid, kill many of the pathogens that are swallowed in food or mucus.

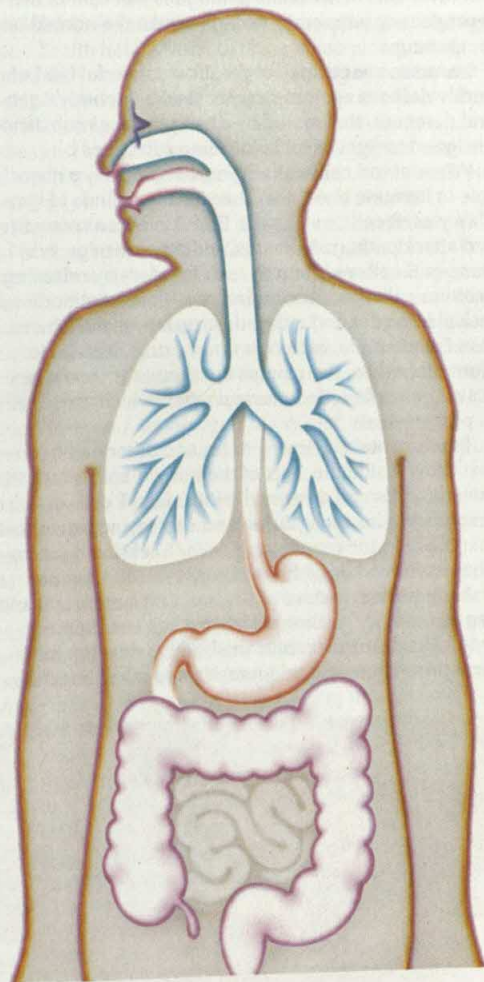
Finally, the bacteria that normally live harmlessly on the skin and in the mouth and intestines provide a barrier against infections. These resident bacteria actually crowd out many disease-causing microorganisms that might otherwise establish colonies on or in the body. Resident bacteria also produce substances that kill or damage certain pathogens.

**General defence reactions.** In spite of the body's barriers against pathogens, some do manage to invade the body. After a foreign substance has entered the body, certain general reactions take place. First, the tiniest blood vessels at the site of the infection begin to leak fluids and cells. The fluids contain various germ-killing chemicals. Most of the cells are white blood cells known as *neutrophils*. Neutrophils can surround and digest invading bacteria—a process called *phagocytosis*, from a Greek word *phagein*, meaning to eat up.

If the invading pathogen is a virus, the body attempts to counteract the virus by producing a chemical called *interferon*. Interferon is released by cells that have been infected by the virus. It enters the bloodstream and is carried to other cells. Interferon stops viruses from infecting these cells.

### Barriers against infections

The body's first defence against infectious diseases includes mechanical, chemical, and biological barriers against germs. This diagram illustrates some of the body's chief barriers.



**Skin.** The tough, dead cells that make up the outer layer of the skin provide an extremely effective mechanical barrier against pathogens.

**Tears** continuously flow over the surface of the eyes, washing out foreign particles and providing chemical protection against many pathogens.

**Mucous membranes** produce sticky mucus that traps germs. Tiny, hairlike *cilia* push mucus from the lungs and trachea up to the mouth.

**Stomach juices** are so high in acid that many microorganisms cannot survive in them. The juices also contain disease-fighting chemicals.

**Resident bacteria** live harmlessly on the skin and in the mouth and intestines. They crowd out or kill many disease-causing microorganisms.



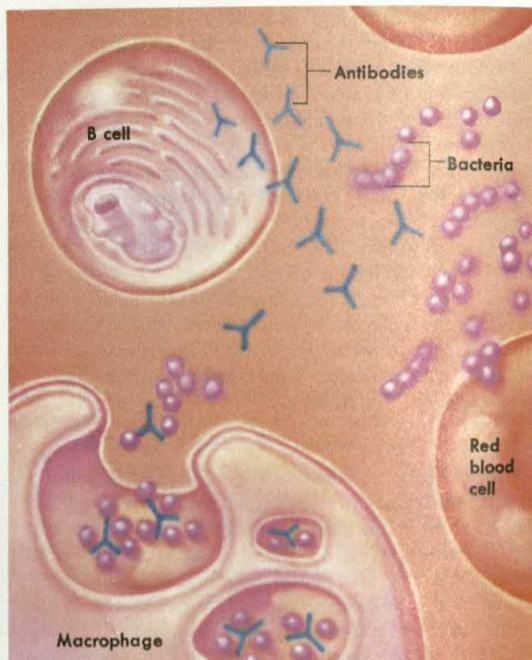
Fever is another reaction that accompanies many infections. The body's higher temperature during a fever increases the rate of many of the immune system's chemical reactions and speeds up the movement of white blood cells. In addition, some researchers believe that fever kills or weakens pathogens that cannot live or reproduce at temperatures higher than the normal body temperature.

**Immune reactions** are the most powerful kind of bodily defence against disease. Unlike the body's general defences, the immune system produces substances designed to fight specific invading substances.

White blood cells called *lymphocytes* play a major role in immune reactions. There are two kinds of lymphocytes, B cells and T cells. Both kinds can recognize and attack pathogens, toxins, and other foreign substances. B cells respond to such invaders by releasing proteins called *antibodies* into the blood. Antibodies attack the invader and either destroy it or make it harmless. For example, antibodies may cause bacteria to clump together. The clumps are then eaten by large scavenger cells called *macrophages*, which are capable of phagocytosis.

T cells protect against viruses and other pathogens that grow inside the cells of the body. T cells attack the infected cells and destroy the intruders. T cells are also responsible for recognizing and destroying cancer cells. In most immune reactions, B cells, T cells, and macrophages all work together to overpower the invader.

An important feature of the immune system is that it can "remember" pathogens after it has encountered them. This feature enables the body to develop long-term protection—called *immunity*—to many infectious



**An immune reaction** involves a number of different body cells. White blood cells called *B cells* release disease-fighting proteins called *antibodies*. In this illustration, antibodies are attracting clumps of invading bacteria. These clumps are then surrounded and destroyed by large cells called *macrophages*.

diseases. For example, after a person has had measles, the immune system will remember the measles virus. The next time this virus enters the body, it will be attacked immediately and destroyed by immune system cells specifically designed to combat it. For this reason, a person normally gets measles only once. See **Immune system**.

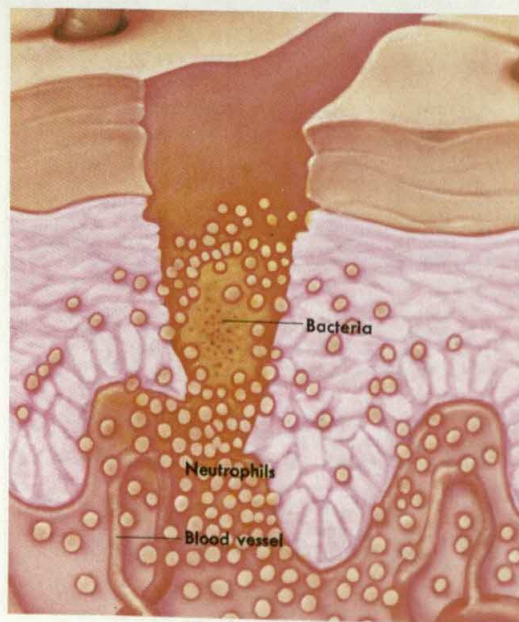
### The battle against disease

The fight against disease is probably as old as humanity. For a detailed history of this battle, from prehistoric times to the age of modern medicine, see **Medicine (History)**. Today, the struggle to conquer disease involves four chief elements. They are (1) diagnosis, (2) treatment, (3) prevention, and (4) research.

**Diagnosing disease**—that is, identifying a disorder—is the first step toward a cure. Many different illnesses produce similar symptoms. Therefore, the doctor must carefully identify which disease a patient has to determine the best course of treatment.

The doctor first reviews the patient's medical history and asks the patient to describe the symptoms of the present illness. The doctor also asks about the development of the illness, the health of others in the family, and similar matters that might help pinpoint the disease.

The doctor then examines the patient, noting the body temperature, pulse rate, breathing, and blood pressure. The examination is concentrated on those parts of the body involved in the patient's symptoms. The doctor may wish to obtain additional information from laboratory tests. A medical laboratory can provide



**The body's general defences** take over if pathogens manage to slip through the barriers. This illustration shows bacteria entering the body through a break in the skin. Nearby blood vessels have released *neutrophils*, white blood cells that can surround and digest the invading bacteria.





**Laboratory tests** play an important role in the diagnosis of many diseases. The lab technician pictured above is working to identify bacteria found in samples of patients' body fluids.

X rays that show abnormalities in the bones, lungs, heart, and other organs. The laboratory also can test blood, urine, and other body fluids for evidence of certain diseases. After considering all the information, the doctor reaches a diagnosis of the patient's illness.

**Treating disease** sometimes involves no more than prescribing rest and a healthy diet. The body has great healing powers, and such measures may be all it needs to overcome a mild illness. But more serious diseases may require a specific course of treatment, including drugs, surgery, or other forms of therapy.

**Drugs** are one of doctors' most important weapons against disease. Antibiotics can cure bacterial infections that once were often fatal. Many fungal and worm infections also can be treated effectively with drugs, but most viral infections cannot.

Drugs also help control many noninfectious ailments. Many cancers can be slowed, or even cured, with drugs. High blood pressure can be controlled with medication, and drugs containing hormones are used to treat hormonal diseases. Aspirin and other pain relievers help arthritic patients lead a more active life.

**Surgery** enables doctors to remove diseased tissues that threaten the rest of the body. For instance, surgical removal of all or part of a cancerous organ may halt the spread of the disease to other organs. Similarly, surgeons may remove an infected appendix or gallbladder to prevent the infection from spreading to other organs.

Surgeons also can repair or replace diseased organs. For example, many heart defects can be corrected surgically. Surgeons can replace diseased bones and joints with metal or plastic parts. They can even replace a diseased kidney or heart with a healthy organ from another person's body (see *Tissue transplant*).

**Other treatments** include radiotherapy, special diets, and rehabilitation therapy. Radiotherapy makes use of X rays and radioactive sources to kill cancer cells. Special diets can control PKU and other hereditary diseases in which the body cannot use certain foods. Diet also plays a major role in treating diabetes mellitus. Rehabili-

tation therapy can help patients regain use of certain parts of their body. Such treatment aids people who have had strokes or other disabling diseases.

**Preventing disease** involves the cooperation of the individual, the medical profession, and various public services.

**Individuals** can help prevent disease by developing good health habits. Such habits include eating a balanced diet, exercising regularly, getting adequate rest and relaxation, and practising personal cleanliness. People also can protect their health by not smoking cigarettes and by avoiding excessive use of alcohol and other drugs. For additional information on the basic elements of personal health, see the article **Health**.

**The medical profession** provides many services that aid in disease prevention. Doctors and other health care specialists may help prevent disease by screening people for certain conditions which enable treatment to be given early so that the chance of a cure is much higher. Such conditions include cancer of the cervix and cancer of the breast. The use of stethoscopes, *sphygmomanometers* (instruments which measure blood pressure), blood tests and *radiographs* (X-ray pictures) help doctors detect diseases. Many diseases can be treated more effectively if detected early.

Doctors protect patients from many serious diseases through active and passive immunizations. Active immunizations involve the use of *vaccines*, which are drugs that contain dead or weakened pathogens. Vaccines stimulate the body's immune defences against a particular disease-causing agent. Active immunizations can prevent many serious childhood illnesses, including diphtheria, rubella, hepatitis B, measles, meningitis (*Haemophilus influenza* type B), mumps, polio, tetanus, and whooping cough. See the article **Immune system**.

In passive immunizations, doctors use serums to protect people who already have been exposed to a disease. Serums contain antibodies from a person or animal that is immune to the disease.

**Public services** help prevent disease in a number of ways. In most industrial countries, public services purify community water supplies, inspect foods for microorganisms and harmful chemicals, and ensure the safety and effectiveness of drugs. Local health departments oversee the sanitary disposal of sewage and wastes, and conduct programmes to control insects, rats, and other animals that spread diseases. The government also protects the public from environmental pollution and inspects workplaces for hazards. Health clinics conduct immunization programmes. They may also provide free testing for high blood pressure and for other diseases. Government-sponsored nutrition programmes help to safeguard the health of children and mothers. In addition, community health workers help to educate the public about good health habits.

**Research** into the causes and treatments of illnesses is perhaps the most important weapon in the fight against disease. Major advances in medical care and prevention depend on such basic research. For example, without the fundamental understanding of how bacteria reproduce, scientists could not have developed successful antibiotics. Basic research on cells and tissues has led to the development of such lifesaving surgical procedures as heart transplants.





A good health service is essential to prevent the spread of disease. In Vietnam, U.S. Army veterans have helped to establish a hospital for children at Vinh. One of the veterans, left, is presented with a bouquet by Vietnamese children.

The development of new drugs often involves many years of laboratory experimentation. In addition, new drugs must undergo extensive clinical trials to prove their safety and effectiveness.

**Related articles.** For articles on specific diseases of organs or parts of the body, see the *Related articles* in such articles as **Blood, Lung, and Skin**. See also the following articles:

#### Symptoms of disease

Backache	Dyspepsia	Insomnia
Bleeding	Fainting	Itch
Colic	Fatigue	Jaundice
Constipation	Fever	Nausea
Convulsions	Haemorrhage	Pain
Cough	Headache	Pus
Cramp	Hiccup	Shock
Diarrhoea	Indigestion	Vomiting
Dizziness	Inflammation	

#### Organs and conditions

Birth defect	Kidney (Kidney diseases)
Blindness (Diseases)	Liver (Diseases of the liver)
Brain (Disorders)	Lung (Diseases of the lungs)
Deafness	Senility
Eye (Diseases of the eye)	Teeth (Diseases and defects of the teeth)
Heart (Coronary artery disease)	

#### Other related articles

Allergy	Holistic medicine	Pathology
Bacteria	Immune system	Plant (Plant enemies)
Cell (The cell in disease)	Interferon	Prion
Drug	Malnutrition	Quarantine
Epidemic	Medicine	Rickettsia
Fungal disease	Mental illness	Virus
Gnotobiotics	Microbiology	
Heredity (Hereditary disorders)	Parasite	

#### Outline

##### I. Infectious diseases

- A. Bacterial diseases
- B. Viral diseases
- C. Other infectious diseases
- D. Spread of infectious diseases

##### II. Noninfectious diseases

- A. Chronic, degenerative diseases
- B. Cancer
- C. Hormonal diseases
- D. Congenital diseases
- E. Environmental and occupational diseases
- F. Nutritional diseases
- G. Immunological diseases
- H. Psychosomatic diseases

##### III. How the body fights disease

- A. Barriers
- B. General defence reactions
- C. Immune reactions

##### IV. The battle against disease

- A. Diagnosing disease
- B. Treating disease
- C. Preventing disease

#### Questions

Which disease is often called "the silent killer"? Why?

Under what conditions do the body's "resident" bacteria sometimes cause diseases?

How can a regular checkup help in disease prevention?

What are *fungi*? What are some diseases they cause?

What is an *autoimmune reaction*? What is an example of disease that involves such a reaction?

What are two of the body's chemical barriers against infections?

What is an *epidemic*?

What are *lymphocytes*?

What role do lymphocytes play in the body?

What are *carriers*?

Why is it important to identify carriers?

What are some of the procedures for diagnosing a disease?





A **dislocation** of the spinal column can cause severe pain and restrict the patient's movement and mobility.

**Dish.** See Porcelain; Pottery; Stoneware.

**Disinfectant** is any substance that destroys germs on nonliving objects. Most common disinfectants are powerful chemicals that people use to cleanse clothing or bedding, sick rooms, and instruments and utensils. Some disinfectants include deodorizers. Detergents are added to many disinfectants to sterilize and aid cleaning. Substances called *antiseptics* are used to kill germs on living tissue.

Disinfectants are most effective when added to community water and sewage systems to destroy germs and help prevent epidemics. They also help stop the spread of germs in hospitals and other health care institutions. However, general household disinfectants have only limited value in stopping the spread of disease. In most cases, washing with soap and water is as effective as using a disinfectant.

Important disinfectants include (1) alcohols, (2) formaldehyde and glutaraldehyde, (3) hypochlorites, (4) iodophors, (5) phenols, (6) pine oil disinfectants, and (7) quaternary ammonium compounds.

**Alcohols**, such as ethyl and isopropyl alcohols, are used to disinfect clinical thermometers and previously cleaned plastic and rubber goods.

**Formaldehyde and glutaraldehyde** are strong and fast acting. Hospitals use them to disinfect surgical instruments and other medical devices.

**Hypochlorites**, including chlorine bleaches and chlorinated lime, are common ingredients of household disinfectants and deodorizers. They are also used in water and sewage treatment and to disinfect kitchen utensils.

**Iodophors** are compounds that include iodine. They are used to cleanse large surfaces in hospitals and to disinfect equipment used in food preparation.

**Phenols** include carbolic acid, creosote, and hexachlorophene. They are used to disinfect floors, rubbish bins, toilet facilities, and other surfaces.

**Pine oil disinfectants** are commonly combined with detergents to clean floors, walls, and bathroom fixtures. They have a pinelike odour.

**Quaternary ammonium compounds** are in many all-

purpose household cleaners. They serve as both disinfectants and detergents.

**Related articles in World Book include:**

Antiseptic	Creosote	Deodorizer
Chlorine	Cresol	Formaldehyde

**Dislocation** occurs when any part of the body moves from its normal position. The term usually refers to the movement out of normal position of the bones of a joint (see **Joint**). When bones become dislocated, they do not meet properly at the joint. This usually results in pain and swelling.

Sometimes in dislocation the bones of a joint are pulled out of place only slightly. Doctors call this a *subluxation* or *incomplete dislocation*. In other cases, the bones become completely separated from each other. This is a *complete dislocation*. A doctor corrects a dislocation by manipulating the bones to return them to their normal position. This procedure is called *reducing* the dislocation. Some dislocated joints may return to their normal position naturally. In *simple dislocation*, the patient has no external wound. A *compound dislocation* is one accompanied by a wound opening from the body surface. When a dislocation occurs in the same joint many times, doctors say it is *habitual*.

Some types of dislocation are *congenital*, or present at birth. These may be hereditary, or may be caused by some factor before or during birth. An example is congenital dislocation of the hip.

See also **First aid** (Fractures and dislocations).

**Dismal Swamp** is one of the largest swamps in the United States. It covers about 1,940 square kilometres in



**Dismal Swamp** is a tangle of vines and various kinds of trees. It is one of the largest swamps in the United States.

northeastern North Carolina and southeastern Virginia. For location, see **North Carolina** (physical map). Dismal Swamp is a tangle of vines and bald cypress, black tupelo, pine, and white cedar trees. It contains much partly decayed plant life called *peat*. Its wildlife includes bear, deer, grey fox, opossum, and snakes. Part of the original 5,200 square kilometres of Dismal Swamp was cleared for farming. In 1973, the U.S. Congress established part of the swamp as the Great Dismal Swamp National Wildlife Refuge.





**Disney theme parks and expositions** attract millions of visitors annually. Walt Disney World, left, and Disneyland feature exhibits, rides, and shows partly based on films by Walt Disney Productions. Walt Disney World's EPCOT Center, right, emphasizes displays of future technology.

**Disney, Walt** (1901-1966), was one of the most famous film producers in history. Disney first became known in the 1920's and 1930's for creating such cartoon film characters as Mickey Mouse and Donald Duck. He later produced feature-length cartoons, films about wild animals in their natural surroundings, and films starring human actors. The Disney studio has won more than 50 Academy Awards for its films and for scientific and technical contributions to filmmaking.

Disney achieved one of his greatest successes in 1955, when he opened Disneyland, a spectacular theme park in Anaheim, California, U.S.A. Most of the exhibits, rides, and shows at the park are based on Disney film characters.

**Early life.** Walter Elias Disney was born in Chicago,

Illinois, U.S.A. His family moved to Missouri, and he spent much of his boyhood on a farm near Marceline. At 16, Disney studied art in Chicago. In 1920, he joined the Kansas City Film Ad Company, where he helped make cartoon advertisements to be shown in cinemas.

**The first Disney cartoons.** In 1923, Disney moved to Los Angeles to become a filmmaker. After he failed, he returned to drawing cartoon films. He set up his first studio in a garage. For several years, Disney struggled just to pay his expenses. He finally gained success in 1928, when he released the first short cartoons that featured Mickey Mouse. Earlier filmmakers had found that animals were easier to animate than people. Mickey Mouse, drawn with a series of circles, proved ideal for animation.

In 1927, sound had been added to motion pictures, and a process for making films in colour was developed a few years later. Disney and his assistants made imaginative use of sound and colour. Disney provided Mickey Mouse's voice. His cartoon *Flowers and Trees* (1932) was the first film in full Technicolor.

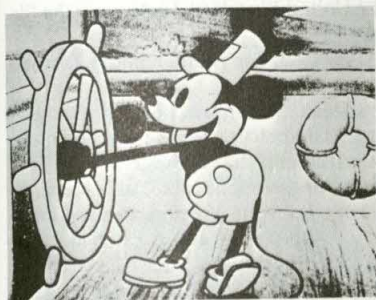
From 1929 to 1939, Disney produced a cartoon series called *Silly Symphonies*. Mickey Mouse appeared in these and later cartoons, along with such characters as Donald Duck, Goofy, and Pluto. Throughout his career, Disney actually drew few cartoons. His genius lay in creating, organizing, and directing the films.

**Full-length films.** In 1937, Disney issued the first full-length cartoon ever made, *Snow White and the Seven Dwarfs*. It became one of the most popular films in history. Disney's later full-length animated films included *Pinocchio* (1940), *Fantasia* (1940), *Dumbo* (1941), *Bambi* (1942), *Cinderella* (1950), *Alice in Wonderland* (1951), *Peter Pan* (1953), *Lady and the Tramp* (1955), and *The Jungle Book* (issued in 1967, after his death). In 1950, Disney released *Treasure Island*, his first full-length film using



**Cartoon characters** made Walt Disney famous throughout the world. Donald Duck first appeared in a short cartoon in 1934. In 1942, the full-length cartoon *Bambi* starred Flower, the skunk; Thumper, the rabbit; and Bambi, the deer.





**Disney films** have featured both cartoon characters and human actors. Mickey Mouse starred in *Steamboat Willie*, upper left, the first cartoon to use sound. *Mary Poppins*, left, combines human actors with cartoon scenes. The film describes the adventures of a nursemaid who can fly. *Pinocchio*, above, is a full-length cartoon about a puppet named Pinocchio. Near the story's end, a whale swallows Pinocchio and Geppetto, the puppet's father. They escape from the whale's stomach on a raft.



only human actors. *Mary Poppins* (1964), which combines human actors with animation, probably is the most successful of Disney's later films.

During World War II (1939-1945), Disney's studio made educational films for the United States government. After the war, Disney created fewer animated films. He concentrated on making films that starred real animals or human actors.

In 1949, Disney released *Seal Island*. This short film

was the first in a series of "True-Life Adventures" that show how animals live in nature. Disney released his first full-length nature film, *The Living Desert*, in 1953. All his nature films include scenes of animal life rarely seen by human beings.

After television became popular in the U.S.A. about 1950, many filmmakers either ignored television or fought it as a threat to the film industry. But Disney adjusted easily to the new form of entertainment. He produced a number of films especially for television and served as the host of a weekly television show that presented Disney films.

**Walt Disney Productions**, with headquarters in Burbank, California, carried on Disney's work after his death. Walt Disney World, a theme park resembling Disneyland, opened near Orlando, Florida, in 1971. In 1982, the company opened a permanent world's fair called EPCOT Center in Walt Disney World. Disney himself had named the centre, which features futuristic technology exhibits. EPCOT is a word made from the first letters of *E*xperimental *P*rototype *C*ommunity of *T*omorrow. In 1983, a Disneyland opened in Tokyo with Japanese sponsors. This park combines the most successful features of the American Disneyland and Walt Disney World with its own attractions. In 1989, plans were announced for a Disney World park in France.

The parks account for most of the money earned by Walt Disney Productions. The rest of the profits come from films and the sale of publications, video cassettes, videodiscs, and merchandise based on Disney film characters. The filmmaking division of Walt Disney Productions was not as successful in the 1970's and early



Walt Disney opened the Disneyland theme park in 1955. The park was based on many of the cartoon characters that Disney developed in a filmmaking career that began in the 1920's.



1980's. Notable films from the company included the animated *The Fox and the Hound* (1981), the science-fiction drama *Tron* (1982), and the comedies *Splash* (1984), *Down and Out in Beverly Hills* (1986), *Ruthless People* (1986), and *Three Men and a Baby* (1987).

See also **Monorail** (picture); **Film industry** (picture: *Snow White and the Seven Dwarfs*); **United States** (The arts [picture]).

**Dispersion.** See **Light** (Dispersion).

**Displaced person.** See **Refugee**.

**Displacement behaviour** refers to any of a variety of activities that seem inappropriate in the situation in which they occur. For example, some mammals groom their fur when faced with a decision of whether to fight or run away. Most displacement behaviour occurs during times of emotional conflict.

**Disraeli, Benjamin** (1804-1881), was one of the most important British political leaders of the 1800's. He served as prime minister of Great Britain in 1868 and again from 1874 to 1880. He was the first person of Jewish ancestry to become prime minister in Britain.

Disraeli was born in London. His father, Isaac D'Israeli, was a well-known author. D'Israeli had Benjamin baptized into the Church of England at the age of 13. In the 1820's, the younger Disraeli also began a writing career. But in time he decided to enter politics. After several failed attempts to win a seat in Parliament, Disraeli was elected to the House of Commons as a Conservative in 1837.

In Parliament, Disraeli became a leading spokesman of the most conservative interests. He opposed the repeal of the Corn Laws, which taxed the import of grain into Britain. In 1846, Disraeli became a leading figure of the Conservative Party in the House of Commons. In 1852, 1858, and 1866, he became chancellor of the exchequer in Conservative governments that the Earl of Derby headed from the House of Lords.

Disraeli played an important role in the passage of the Reform Bill of 1867. The bill brought greater democracy to Great Britain by giving the vote to many city workers and small farmers. In 1868, Disraeli became prime minister. He lost the position to William Gladstone, the leader of the Liberal Party, later in 1868 but regained it from Gladstone in 1874.

As prime minister, Disraeli followed a strong foreign policy. In 1875, he purchased for Britain a large interest in the Suez Canal, which was a key link in the shipping route that connected Britain and its vast empire in India and the Far East. At the Congress of Berlin in 1878, Disraeli helped prevent Russian expansion in Turkey and acquired Cyprus for Britain. The Disraeli government also worked to improve living conditions in Britain.

Disraeli wrote several novels dealing with politics and high society. He was made Earl of Beaconsfield in 1876.

See also **Conservative Party**; **Corn Laws**.

**Dissection.** See **Anatomy**.

**Dissenters.** See **United Kingdom, History of** (The Glorious Revolution).

**Dissociative disorder.** See **Mental illness** (Dissociative disorders).

**Distance** is the space between two points. It can be measured in metres, kilometres, centimetres, and many other units of measurement. The vast spaces between the stars and planets, or astronomical distances, are measured by the speed of light. Astronomers say, for example, that a star is six *light-years* away, which means that light reaches the earth six years after it leaves the star. Light travels at a speed of 299,792 kilometres per second. In one year, light travels 9,460,000,000,000 kilometres. If a star is 10 light-years away, it is about 100,000,000,000,000 kilometres away.

Ordinary distances, such as a few kilometres, are too small to have meaning in astronomy. But these same distances are extremely large in other sciences. In biology and physics, scientists can measure the distance between two cells, or between atoms in a crystal. Scientists measure such distances in micrometres (millionths of a metre), or in nanometres (thousandths of a micrometre).

**Related articles in *World Book* include:**  
Astronomy (Measuring distances in space)  
Measurement (Length and distance)  
Metric system (Length and distance)  
Parallax  
Telemetry  
Weights and measures (Length)

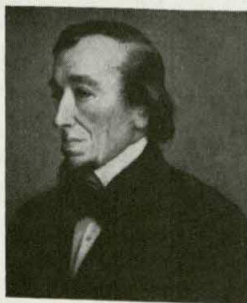
**Distemper** is a contagious disease of dogs and other animals. In dogs, it is caused by a virus called *paramyxovirus*. This virus affects chiefly young dogs and is often fatal. The word *distemper* also refers to different diseases in horses and cats.

A dog with distemper suffers from fever, reddened eyes, loss of appetite, a dry mouth, and discharges containing pus from the nose and eyes. As the disease progresses, pneumonia may occur and bring on coughing and heavy breathing. The virus frequently spreads to the brain and results in jerking motions of the head, jaw, and other parts of the body. This motion is called *chorea*. Brain infection usually leads to death.

Distemper in horses is caused by *Streptococcus equii* bacteria. In young horses, this disease is called *strangles*. The horse suffers from a sore throat, fever, and swollen lymph glands.

Distemper in cats is called *panleukopenia*, also known as *feline enteritis*, *cat distemper*, or *feline distemper*. It is caused by a virus called *parvovirus* and infects the bone marrow, intestine, and lymphoid tissue. The cat suffers from diarrhea, a runny nose, and reddened and runny eyes. Many cats with panleukopenia die. Vaccination can protect cats from it.

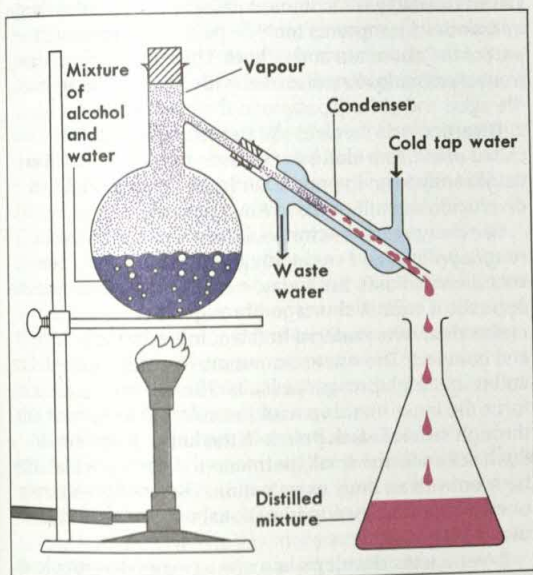
**Distillation** is a process that separates a substance or a mixture of substances from a solution through vaporization. Many industrial processes depend on distillation. Distillation usually involves boiling a liquid and condensing the vapour that forms. When water boils, it turns into vapour. Through distillation, the vapour can be collected and condensed to form *distilled water*. The distilled water is purer than the original water because salt and other impurities do not evaporate along with the water.



Benjamin Disraeli



## Types of distillation



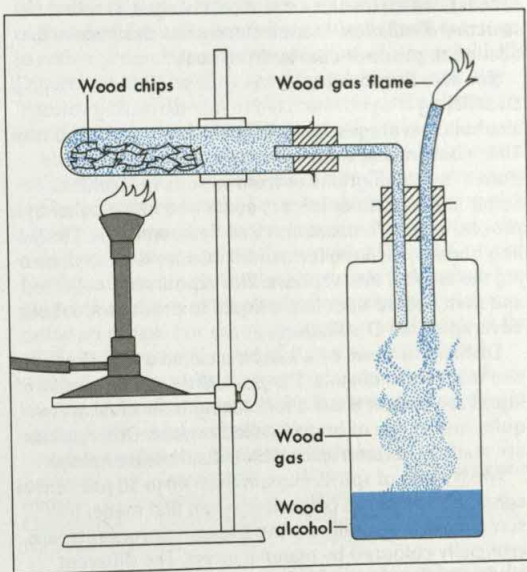
**Simple distillation** separates substances in a liquid. It can be demonstrated by heating a mixture of alcohol and water in a flask. When the mixture boils, it turns into vapour. The vapour has a higher percentage of alcohol than the liquid mixture did, because alcohol boils at a lower temperature than water. The vapour liquefies in the condenser and flows into the receiver.

Distillation is carried out in an apparatus called a *still*. A still consists of a *boiler*, a *condenser*, and a *receiver*. The mixture to be vaporized is heated in the boiler. Whichever substance in the mixture boils at the lowest temperature will be the first to turn into vapour. The vapour enters the condenser, where it cools and becomes liquid again. The distilled liquid, called the *distillate*, then collects in the receiver.

Two general methods are used to distill liquids, *simple distillation* and *rectification*. In simple distillation, all the distillate is removed from the still after collecting in the receiver. In rectification, part of the distillate flows back into the still. This portion of the distillate comes into contact with the vapour being condensed and thus enriches it.

**Simple distillation.** Two common techniques used in this method of distillation are *fractional distillation* and *flash distillation*.

**Fractional distillation**, also called *differential distillation*, separates a mixture of liquids that boil at different temperatures. For example, ethyl alcohol boils at 78° C, and water boils at 100° C. When a mixture of these liquids is heated, the alcohol vaporizes faster than the water. But the water vaporizes fairly rapidly at the boiling point of alcohol. As a result, the distillate from a mixture of alcohol and water contains some water. The first distillate collected has a larger proportion of alcohol than the portions that condense later. Therefore, the first distillate is removed before much water distillate has condensed. In the same way, the remaining distillate is re-collected in *fractions* (portions), which can then be re-distilled for a purer product. Fractional distillation is



**Destructive distillation**, which involves chemical changes in solids, produces new substances. It can be shown by heating wood chips in a closed tube at a temperature high enough for the wood to *decompose* (separate chemically). This decomposition produces wood gas. The gas burns with a luminous flame if lit. When the gas condenses in the jar, it forms wood alcohol.

used in making distilled liquors. See **Alcoholic beverage; Distilling**.

**Flash distillation** involves passing a liquid from a vessel maintained at a high pressure to one kept at a lower pressure. No heating is required to produce vapour by this method. The lower pressure causes part of the liquid to *flash* (turn quickly) into vapour, which is then condensed into distillate. In fractional distillation, the distillate can be processed only in batches. But in flash distillation, a continuous flow of liquid can be distilled. Flash distillation is widely used to turn ocean water into fresh water. See **Water** (Distillation).

**Rectification** separates many different substances from a solution by using large towers called *fractionating columns*. As the mixture is heated, its vapours rise through these columns. Substances that boil at the lowest temperatures form the first fractions. Their vapours rise highest and are carried off by pipes near the tops of the fractionating columns. Separate pipes carry off different fractions at various levels. The *reflux* (return) of some distillate to the columns produces the most efficient conditions for this method of distillation. Rectification plays a role in industrial chemical processing, including petroleum refining. See **Petroleum** (Refining petroleum).

**Destructive distillation.** No new substances are formed during simple distillation or rectification. Each of these processes simply separates substances that have been mixed together. But when some solids are heated in a closed vessel, they *decompose* (separate chemically) and produce new substances. For example, wood heated in an airtight tube decomposes into wood gas,



which in turn condenses and forms wood alcohol. This process, which involves chemical changes, is called *destructive distillation*. Manufacturers use destructive distillation to produce coal tar from coal.

See also **Evaporation**.

**Distilling** is a process used in manufacturing various alcoholic beverages, including whisky, brandy, and rum. These beverages, sometimes called *spirits*, are made from a "mash" of grains or from various fruit juices. Sugar in the mash or juice is converted into alcohol by a process called *fermentation* (see **Fermentation**). Distilling begins when the fermented mixture is heated, turning the alcohol into vapours. The vapours are collected and then cooled back into a liquid to produce alcoholic beverages (see **Distillation**).

Distilling is done by a machine called a *still*. There are two main types of stills. The *pot still* distills one batch of liquid at a time. It is used for making Irish whiskey, tequila, and a type of brandy called *cognac*. Other spirits are made in *column stills*, which distil continuously.

Most kinds of spirits contain from 40 to 50 per cent alcohol. All spirits are colourless when first made, but some darken naturally during the aging process or are artificially coloured by manufacturers. The different kinds and flavours of distilled alcoholic beverages depend on the type of fermented mixture used. Distillers produce brandy from fermented fruit juices. Whisky and vodka are made from several kinds of fermented grain mash, including corn, rye, and wheat. Rum is made from fermented molasses or sugar cane juice. Tequila comes from the fermented juices of the maguey plant. Manufacturers blend alcohol vapours with additional flavouring materials to make gin and cordials.

See also **Alcoholic beverage; Whisky**.

**District of Columbia (D.C.)** is the seat of the United States government. It covers 179 square kilometres along the Potomac River between Maryland and Virginia. The city of Washington covers the entire District. For more information, see **Washington, D.C.**

**Disulfiram** is a drug used to treat alcoholism (see **Alcoholism**). It is commonly known by the trade name Antabuse. Disulfiram does not cure alcoholism, but it discourages people from drinking alcoholic beverages. People who take disulfiram become sick if they drink alcoholic beverages. Symptoms include heavy breathing, dizziness, and vomiting.

People taking disulfiram should avoid any product that contains alcohol. For example, cough syrup, tonics, and even after-shave lotion may result in sickness. When alcohol is avoided, there may be only mild side effects, such as drowsiness, headaches, or skin problems. Disulfiram should be taken only when prescribed by a doctor. Two Danish doctors, Jens Hald and Erik Jacobsen, discovered the usefulness of the drug in 1948.

**Diuretic** is a drug or other substance that increases the secretion of urine by the kidneys. Many substances such as water, glucose solution, tea, coffee, mineral waters, and beer have a diuretic effect on the kidneys. Diuretics are used to treat many diseases in which the secretion and flow of urine are greatly affected, such as when the kidneys are damaged by poisons. They are also used to rid the body of excess fluid, as in oedema.

**Diurnal hibernation.** See **Hibernation**.

**Diver**, a bird. See **Loon**.

**Diversified farming.** See **Agriculture (Mixed farms)**. **Diverticulitis** is a common disease of the *colon* (large intestine). Its symptoms include pain in the lower left part of the abdomen and a fever. The disease develops from *diverticulosis*, a disorder widespread among middle-aged and elderly people in the developed world.

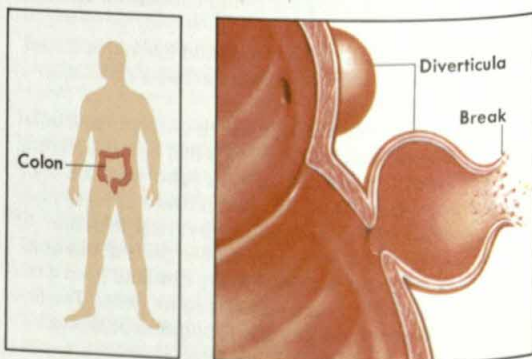
Diverticulosis involves the presence of pouches called *diverticula* along the outside of the colon. Diverticula rarely form in people under the age of 30. Most diverticulosis patients have no symptoms.

For many years, doctors believed that a diet low in *roughage* (fruit and vegetable fibres) would help prevent diverticulosis. But today, evidence suggests that the opposite is true. A shortage of roughage in the diet makes the waste material in the colon extremely firm and compact. The waste cannot move easily through the colon, and high pressure results. This pressure can force the inner membrane of the colon to bulge out through several weak points in the lining of the organ. Such action forms small, permanent diverticula that may be seen with an X-ray examination. The condition rarely occurs in underdeveloped nations, where the standard diet is high in fibre.

Diverticulitis develops in many cases of diverticulosis. It results when one or more of the diverticula are inflamed. The inflamed diverticula may break open. The material that leaks out infects the outer surface of the colon. In most cases, the infection stays in a small area. But it may spread and develop into *peritonitis*, a severe illness that can cause death (see **Peritonitis**).

Doctors treat diverticulitis with antibiotics to control infection, drugs to relax the muscular wall of the colon, and compounds to help empty the colon. In severe cases, surgeons may remove the inflamed part of the colon. A diet high in roughage may help prevent a recurrence of the disease.

**Divide** is a high place in the land, situated so that the streams on one side flow in the opposite direction to the streams on the other side. These streams then flow into different river systems, which may empty into different oceans. The little streams are called the *headwaters* of the river systems. The divide separates the headwaters of the systems. Another name for a divide is *watershed*. A divide may be rather low, like the ridge of



**Diverticulitis** is a disease of the colon. It occurs when a *diverticulum*, an abnormal pouch on the surface of the colon, is inflamed. An inflamed diverticulum may break open, releasing infectious waste materials.



land that runs from east to west across North America. This divide separates the rivers that flow generally northward into the Gulf of Saint Lawrence, Hudson Bay, and the Arctic Ocean from those that flow into the Mississippi basin. Some divides are very high with steep slopes, like the Rocky Mountains. This separates the rivers flowing into the Mississippi from those flowing into the Pacific Ocean. The watershed that runs north and south through the Rocky Mountains is called the *Great Divide* or the *Continental Divide*. On Cutbank Pass in Glacier National Park, also in North America, there are three brooks so close together that a person can pour water into all three at the same time. One brook carries water to Hudson Bay, another to the Pacific Ocean, and the third into the Gulf of Mexico. This point is actually the top of the North American continent. At several places, sources of streams flowing to the Pacific and to the Gulf lie only a short distance apart.

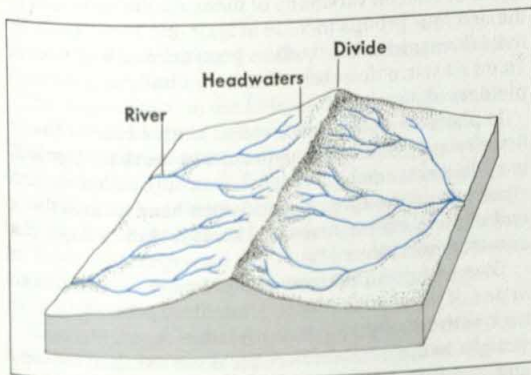
See also *Continental Divide*; *Great Divide*.

**Divider** is an instrument used to divide lines into equal parts. It also transfers dimensions from a ruler to a map or a drawing. A divider measures and plots small distances between two points more accurately than a ruler. It can be used on maps to check the distance between two points against the distance scale.

A divider has two needle-pointed legs, joined together at the top. An adjusting screw changes the distance between the two legs. Dividers range in length from about 8 to 20 centimetres. They are a type of calliper (see *Calliper*).

**Divination** is the practice of trying to learn about the unknown by magical or supernatural means. A diviner supposedly can learn about the past, present, or future. Some diviners believe they can learn the causes of past events, such as a person's illness or death. Other diviners, called *dowsers*, claim they can find the location of underground water. Still others believe they can foretell events, such as when a person will die or whom a person will marry.

There are many kinds of divination. For example, *necromancy* involves communicating with the spirits of the dead. *Astrology* is an attempt to predict events by studying the positions of the sun, moon, stars, and planets. Some diviners interpret dreams to foretell events.



A **divide** is a high area of land that separates river systems from one another. The headwaters of each system form near the top of the divide. The waters join and form streams and rivers.

Another type of divination, called *palmistry*, involves the prediction of events by reading the lines and marks of the hand. Some fortunetellers claim to read messages in coffee grounds, tea leaves, dried mud, or crystal balls. Others use *tarot cards*, a special pack of pictured playing cards, to tell the future. Tarot cards probably originated in Europe in the 1100's.

Throughout history, people have believed in the powers of divination. In ancient Greece and Rome, prophets known as *oracles* foretold events by interpreting messages from the deities. Many people with important decisions to make consulted the oracle at Delphi, Greece.

At one time, courts used divination to determine the guilt or innocence of criminals. Divination in a trial was called an *ordeal*. For example, in many witch trials of the 1600's in Europe and colonial America, a suspected witch was tied up and thrown into water. If she sank, she was considered innocent. If she floated, she was considered a witch—and was executed.

**Related articles in *World Book* include:**

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Fortunetelling	Numerology	Palmistry	

**Divine Comedy** is a beautiful, long epic poem by the Italian writer Dante Alighieri. Dante began the poem about 1308 and finished it just before his death in 1321. Its main theme is life after death, and Dante himself is the chief character. *The Divine Comedy* is divided into the *Inferno* (Hell); the *Purgatorio* (Purgatory); and the *Paradiso* (Paradise). Dante called the work simply *Commedia* (Comedy) because it ended happily. Later generations added the word *Divine*.

Dante divided each of the three parts of the poem into subdivisions called *cantos*. *Purgatorio* and *Paradiso* each contain 33 cantos, and *Inferno* has 34. The cantos have a powerful rhythm because of their three-line *terza rima* stanzas. In this verse form, which Dante invented, the first and third lines of each stanza rhyme with the middle line of the preceding stanza.

The poem begins with Dante lost in a dark forest, symbolizing what he felt was his own unworthy life and the evil he saw in society. On Good Friday, after a night of painful wandering, he meets the Roman poet Virgil, who promises to lead him out of the forest and guide him on a journey through the otherworld. They enter hell, a horrible pit shaped like a cone, located deep within the earth. It has nine circles where they find crowds of suffering individuals who are being punished for their sins by monsters, devils, and other creatures. The damned are well-known historical figures. Some of them are from the past, but most of them are from Dante's own time.

Dante and Virgil leave hell and reach the mountain of Purgatory. From there they climb to bright terraces where the dead, who have gained salvation, seek forgiveness for misdeeds committed on earth. An atmosphere of peace and hope fills this place of purification, in contrast with the great suffering and despair experienced in hell.

On reaching the Earthly Paradise, on top of Mount Purgatory, Virgil entrusts Dante to a new guide, Beatrice. *The Divine Comedy* is in many ways a love poem praising Beatrice's moral beauty and her power to lead



Dante to a vision of supreme goodness. She guides Dante through the 10 spheres of heaven where Dante meets the souls of the blessed. They finally arrive at the throne of God, set among hosts of angels. Dante stands in rapture and perceives at last the final truth of life and the meaning of the universe.

See also **Dante Alighieri**.

**Divine right of kings** is the belief that monarchs get their right to rule directly from God, rather than from the consent or wish of their subjects. According to this belief, it is up to God to punish a wicked king. So far as the people are concerned, "the king can do no wrong." This idea was at its height in England during the reign of the Stuarts and in France under Louis XIV. The first blow at divine right was the execution of the English king, Charles I, in 1649. The French Revolution repudiated the belief, and asserted that the right to rule came from the people. But the divine-right doctrine lasted long after that time. It was asserted in the early 1900s by the German emperor, Wilhelm II, as king of Prussia, and by Czar Nicholas II of Russia.

**Diving** is an exciting water sport. A skilful diver leaps from a springboard or a platform and performs daring acrobatics in the air before plunging into the water. Unlike swimming, diving emphasizes technique rather than endurance or speed. Talented divers combine strength and grace with great courage while spinning and twisting towards the water, finally making an entry with a minimum of splash.

Some divers perform trick dives at water shows, and others plunge into the ocean from cliffs. Such divers have great skill and daring, but they perform and compete as professional entertainers. This article discusses diving as a competitive amateur sport. For information on other forms of diving, see **Diving, Underwater; Skin diving; and Spearfishing**.

### Types of diving

National and international diving meetings consist of two types of competition, *springboard diving* and *platform diving*. In springboard diving, the diver uses the spring from a bouncing board to gain the height necessary to perform a dive. In platform diving, the diver jumps from a high, stationary surface. The great height of the platform gives him or her time to perform various movements before entering the water.

**Springboard diving** is more common than platform diving. Diving boards used in meetings measure 5 metres long and 50 centimetres wide. They extend about 1.5 metres beyond the edge of the pool. Springboard diving competitions are held on boards that are either 1 metre or 3 metres above the water. In international competition since 1990, springboard diving is held on 1-metre and 3-metre boards.

During the 1960s, the development of aluminium diving boards revolutionized springboard diving by making possible many more kinds of dives. Aluminium springboards are thinner and much more flexible than the earlier thick wooden ones. They provide greater spring, making it easier for the diver to spin as well as to gain more height. This increased height and spinning action allows divers to perform a greater variety of dives, including many more difficult ones. Recent innovations in aluminium springboards enable divers to gain

even more height and also to achieve a more rapid spinning action.

**Platform diving.** Diving platforms for meetings must be at least 6 metres long and 2 metres wide. They have a nonskid surface to prevent athletes from slipping. Diving platforms are 10 metres above the water. Some platforms have levels that are 5 metres or 7.5 metres high, but divers use them only for practice, not for competition.

### Diving techniques

Diving is safe for properly trained people, but good diving requires proper coaching and equipment. Beginners risk serious injury if they do not learn proper techniques. Difficult dives should never be attempted from a garden or hotel pool diving board, and someone should be ready to assist in case there is an accident.

The first movement for many dives consists of the *approach* and the *hurdle*. The approach consists of the first steps taken by the diver on the board or platform. The hurdle is the last step—actually a short jump—that takes the diver to the edge of the board or platform. Many elements make up a proper approach and hurdle. For example, the approach steps should be natural and even in length. Steps that are too long or too short may result in shifts in weight that can cause imbalance, resulting in a poor dive.

Some platform dives begin with a *standing start* rather than with an approach and hurdle. For a standing start, the diver stands poised at the platform's edge. Other platform dives begin with a handstand at the edge.

All dives involve certain actions that divers must follow precisely while in the air. Ideally, a diver enters the water vertically, with the body straight and the toes pointed. If the diver hits the water head first, his or her arms should be extended in front of the head in line with the body. If the diver enters the water feet first, the arms should be straight and close to the body.

### Kinds of dives

In springboard diving, there are five basic kinds of dives. They are (1) forward, (2) back, (3) reverse, (4) inward, and (5) twist. Each of the five dives represents a group of dives. Each group consists of basic dives and a series of difficult variations of them. All the variations in the first four groups include at least one somersault. The twist dives add twists to dives from the first four groups. To do a twist, a diver turns his or her body one complete revolution in the air.

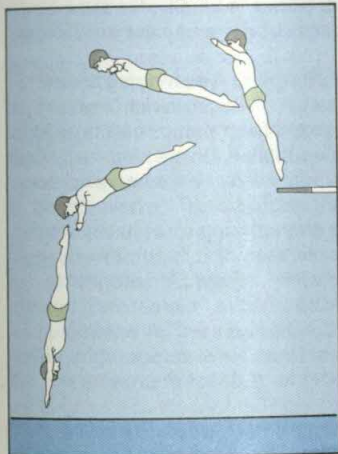
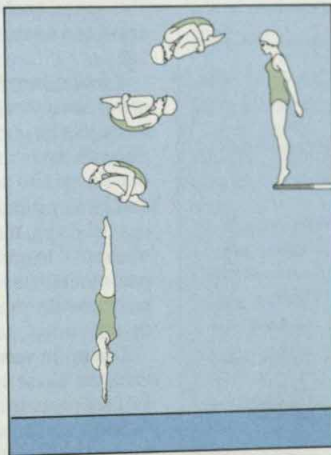
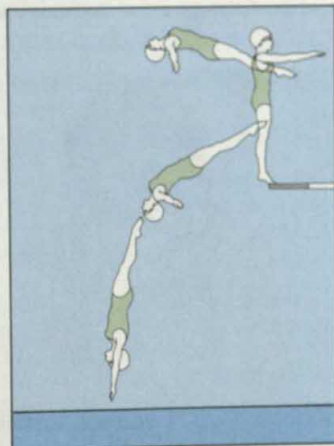
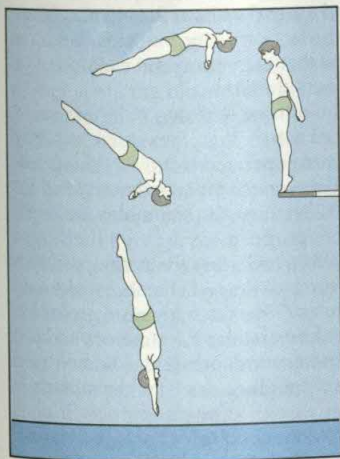
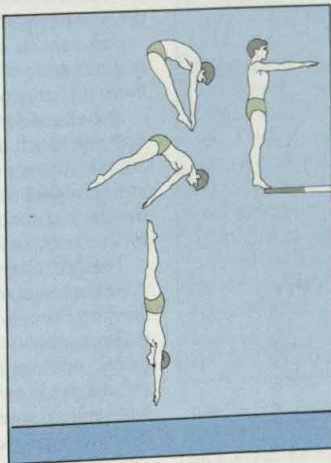
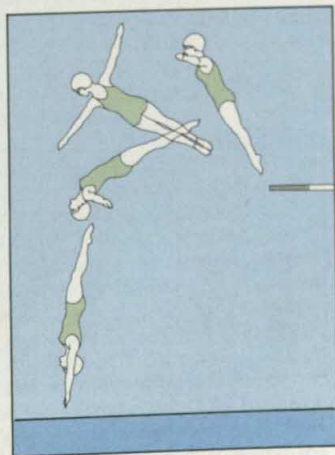
In platform diving, there are six kinds of dives. The first five are from the same groups as those performed in springboard diving. In the sixth group, called the *armstand* group, the diver begins with a handstand at the end of the platform. Armstand dives include a basic dive as well as variations of it.

Divers perform all dives except for some twist dives in one of three positions: (1) straight, (2) pike, and (3) tuck. In the straight position, the diver keeps the body straight. In the pike position, the diver bends at the hips and keeps the knees straight. In the tuck position, he or she draws the knees up towards the chest and grasps the lower legs with the hands. A fourth position, the *free* position, is used only in certain twist dives. Dives in the



**Kinds of dives**

Five kinds of dives are performed in a springboard meeting. These dives, in the order in which they are performed, are (1) forward, (2) back, (3) reverse, (4) inward, and (5) twist. Divers perform the first four dives and certain twist dives in one of three positions: layout or straight, pike, and tuck.

**Forward** (straight position)**Forward 1 1/2 -somersault** (tuck position)**Back** (straight position)**Reverse** (straight position)**Inward** (pike position)**Half-twist** (straight position)

free position combine any of the three other positions, depending on the kind of twist dive.

The illustrations on the following page show examples of various kinds of dives and diving positions.

**Diving, Underwater**, is the way people reach the strange and beautiful world beneath the surface of oceans, lakes, and rivers. Ancient peoples dived under water in search of fish, other water animals, and plants for food. With improved skills and the development of equipment, various other activities began to be performed under water.

Today, divers repair ships, recover valuable objects, build and repair various types of structures, and conduct research. Work can be performed at great depths in specially equipped diving vehicles. In the armed services, divers and submarines carry out military missions. Many people enjoy underwater diving as a sport. They

dive to study underwater life, to take photographs, to hunt water animals, or simply to explore.

**Kinds of underwater diving**

There are two basic kinds of diving: (1) *ambient diving*, in which the diver's body is exposed to the pressure of the *ambient* (surrounding) water; and (2) diving in vehicles that protect divers from the water pressure.

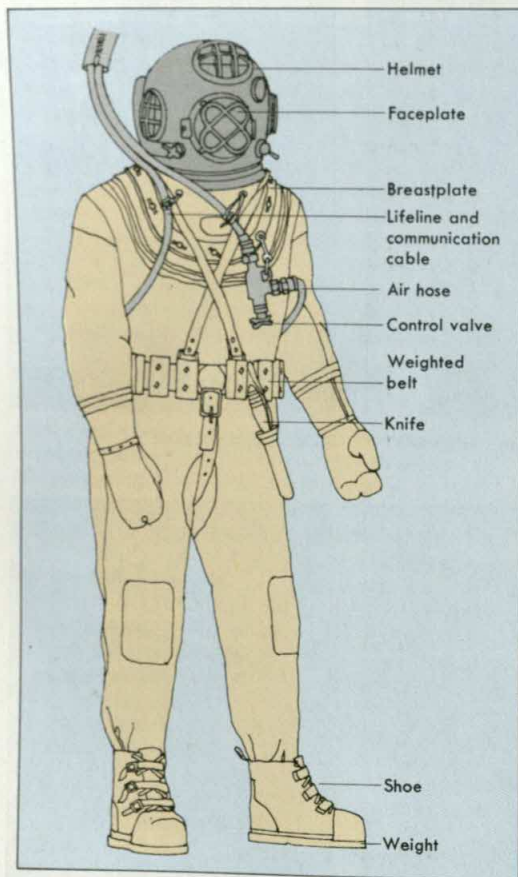
**Ambient diving.** Water pressure on the body increases with the depth of the water. At great depths, this pressure can have dangerous effects on an ambient diver. The three types of ambient diving are (1) breath-hold diving, (2) scuba diving, and (3) surface-supplied diving.

**Breath-hold diving** is the oldest and simplest form of underwater diving. It is also called *free diving*, *skin diving*, and *snorkel diving*. Breath-hold divers may use no



### Surface-supplied diving equipment

In surface-supplied diving, a diver wears a waterproof suit and a helmet for protection against water pressure. Air or breathing gas travels through a hose connected to air pumps on a boat.



equipment at all, but most of them use a face mask, foot fins, and a short breathing tube called a *snorkel*. The snorkel allows the diver to swim at the surface and observe underwater before diving.

Breath-hold diving is a popular form of recreational diving. Most breath-hold divers can go only 9 to 12 metres deep. They must surface to breathe after less than a minute. Some skilled divers can go as deep as 30 metres and stay submerged for as long as two minutes.

**Scuba diving** gives divers greater mobility and range than breath-hold or surface-supplied diving. The word *scuba* stands for self-contained underwater breathing apparatus. A scuba diver wears metal tanks that hold compressed air or a special mixture of breathing gases. The diver breathes from the tanks through a hose. A device called a *demand regulator* supplies the amount of air required. Scuba divers also use a mask and fins.

The most common type of scuba equipment, called *open circuit* scuba, uses air. The diver breathes air from the tank, and the exhaled air is released into the water. *Closed circuit* equipment, also called a *rebreather*, uses

oxygen or a mixture of oxygen and other gases. It filters out the carbon dioxide and other harmful gases from the exhaled gas. More oxygen is added automatically. This action enables the diver to breathe the same air again and again. Closed circuit equipment usually uses 100 per cent oxygen.

**Surface-supplied diving** involves wearing a water proof suit and a helmet. A diver gets air or breathing gas through a hose connected to air pumps on a boat. Most deep diving is surface supplied. Divers wear many kinds of helmets and suits. Some divers wear heavy helmets and canvas suits. Lightweight glass fibre helmets and special diving masks are replacing older helmets made of copper. In addition to hoses that supply breathing gas, other hoses and wires may supply hot water to warm the diving suit, electricity or high-pressure air to operate power tools, and gases used for welding.

**Diving in vehicles.** There are several kinds of diving vehicles. These vehicles keep divers dry, warm, and at surface pressure.

Some divers wear metal suits called *articulated armour*. These suits cover the entire body. Like diving vehicles, articulated armour provides protection against pressure, but it enables the diver to move about more freely. Some types of articulated armour permit the diver to descend and ascend without the aid of cables.

**Submarines** are the largest diving vehicles. Most submarines are warships that carry powerful weapons. For more information, see *Submarine*.

**Submersibles** have extremely strong hulls and can descend much deeper than submarines can. Unmanned submersibles, which are operated using a cable, can descend to about 6,100 metres. Manned submersibles can descend to about 6,500 metres. Submersibles are used for research and other purposes.

The first submersibles, including the *bathysphere* and the *benthoscope*, were ball-shaped chambers with viewing *ports* (windows). They were lowered on cables from ships. Modern submersibles have motors and propellers and can manoeuvre independently. Some receive electric power through cables from the surface, but each submersible carries its own supply of air or breathing gas. Some of these vehicles have external mechanical arms called *manipulators*, which can pick up objects from the ocean floor. Submersibles also have cameras and floodlights that enable scientists to photograph objects and organisms at depths where sunlight never penetrates.

Some submersibles carry tanks of petrol, oil, or a foam composed of tiny glass bubbles. Such light substances help make the craft *buoyant* (able to float). Tanks filled with air, such as those used in submarines, would be crushed by the pressure at great depths.

To descend, some of the buoyancy substance is released and replaced by water, which gives the craft additional weight. To ascend, the craft is lightened by dropping pieces of iron carried for this purpose. Some types of submersibles also use propellers when descending or ascending. A submersible called a *bathyscaph* consists of a steel sphere attached to the bottom of a cigar-shaped hull filled with petrol. In 1960, the bathyscaph *Trieste* made the deepest dive ever recorded. It descended 10,910 metres into the Pacific Ocean. See *Bathyscaph*.



## Dangers of underwater diving

There is greater pressure under water than on land. The pressure increases by almost 0.04 kilogram per square centimetre for each 30 centimetres of depth. For example, the pressure on a diver 10 metres beneath the surface is twice as great as the air pressure at the surface. An ambient diver may be injured if the pressure in the lungs and other air spaces in the body does not equal the water pressure. Such an injury is called *barotrauma* or *squeeze*.

During ascent, the pressure in the lungs must be kept equal to the decreasing water pressure. Otherwise, a serious condition called *air embolism* may result. An ambient diver breathes more molecules of air under water than on land because the air breathed under water is compressed. When the diver rises to the surface, the air in the lungs expands because of the lesser pressure. If the air cannot be exhaled, it will tear the lungs and force air bubbles into the blood. These bubbles can block the flow of blood and cripple or even kill the diver. Air embolism can be prevented by breathing naturally and ascending slowly.

A condition known as the *bends* or *decompression sickness* occurs when nitrogen bubbles form in the blood. Nitrogen gas makes up more than three-fourths of the air breathed by human beings. An ambient diver who breathes compressed air absorbs large amounts of nitrogen into the blood. As the diver ascends, this excess nitrogen is exhaled. But if the diver ascends too quickly, bubbles of nitrogen gas form in the blood. The nitrogen bubbles can block the flow of blood and cripple or kill the diver. A diver can avoid the bends by rising slowly enough to allow the excess nitrogen to be eliminated through breathing.

A chart called a *decompression table* tells a diver how long he or she can stay at a certain depth without absorbing a dangerous amount of nitrogen. It also tells how slowly the diver must ascend to avoid the bends. A person who is suffering from air embolism or the bends should be put into a *decompression chamber* immediately. In this chamber, the diver is returned to a pressure which compresses the bubbles so that the gas dissolves

back into the blood. The pressure is then reduced in stages.

Divers breathing air at extreme depths may also suffer a kind of drugged effect called *nitrogen narcosis*. This condition causes a loss of the ability to reason. Nitrogen narcosis occurs most frequently at extreme depths. To avoid it, divers may breathe a gas mixture that contains helium instead of nitrogen.

A diver who breathes 100 per cent oxygen at great depths may suffer oxygen poisoning. The victim becomes dizzy and vomits and may have convulsions. Gas mixtures with a high oxygen content can also cause oxygen poisoning.

## History

Breath-hold divers dived for shells in the Mediterranean Sea as early as 4500 B.C. Ancient Greek and Roman divers sought pearls, sponges, and shells.

Divers in the Persian Gulf used goggles made of polished clear tortoise shell to see clearly under water as early as A.D. 1300. In the early 1930's, Guy Gilpatric, an American diver, became one of the first to use rubber goggles with glass lenses. By the mid-1930's, face masks, fins, and snorkels had come into use.

The first devices that enabled people to breathe under water were called *diving bells*. These bell-shaped hulls have been used since ancient times. They are open to the water at the bottom and receive air from the surface through a hose. The air pressure within the bell keeps the water out of the device.

In 1715, an English diver named John Lethbridge designed a wooden and leather diving suit that was used in salvage work. The suits used for helmet diving today are based on a diving suit that was introduced in 1837 by Augustus Siebe, a German living in England.

Independent breathing devices for diving appeared during the late 1800's and early 1900's. The first safe and simple device, the *aqualung*, was invented in 1943 by two Frenchmen, Jacques-Yves Cousteau, a naval officer, and Émile Gagnan, an engineer.

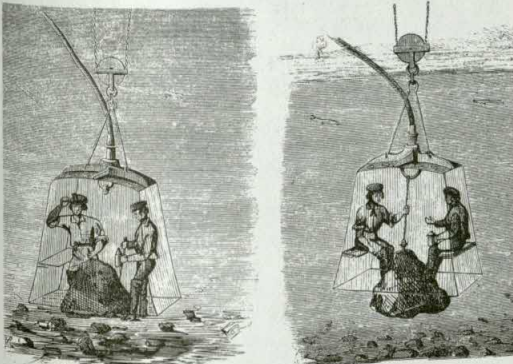
The development of enclosed diving vehicles expanded the range of underwater activity. Otis Barton of the United States designed the bathysphere. In 1930, he and William Beebe, an American naturalist, made the first dive in it. The Swiss physicist Auguste Piccard designed the first bathyscaph in 1948.

Experimental underwater *saturation habitats* were developed in the 1960's. These manned stations consist of one or more buildings erected on the ocean floor. They have been successfully tested at depths ranging from 9 to 180 metres. Compartments inside the buildings are filled with compressed breathing gas. Divers may live there for weeks. They leave the station daily to explore or work. By staying under water, the divers avoid the need to undergo decompression every day. The first saturation habitat was built off the coast of France in 1962 by Cousteau.

**Related articles in *World Book* include:**

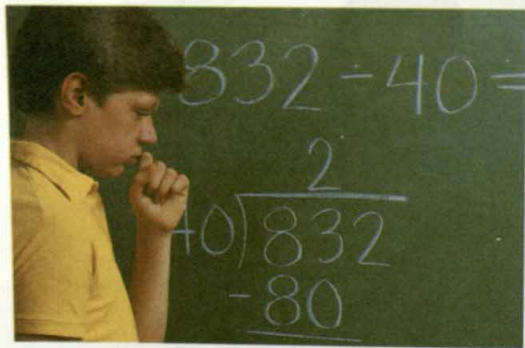
Beebe, William	Marine biology	Piccard (family)
Bends	Ocean (Discovering the secrets of the deep)	Skin diving
Cousteau, Jacques-Yves		Spearfishing
		Submarine

**Diving bell.** See Diving, Underwater (History).  
**Divining rod.** See Well (Locating wells).



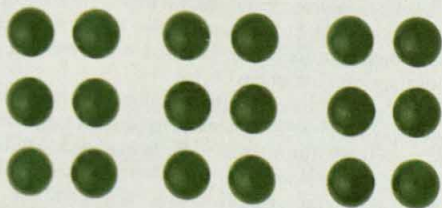
**Diving bells of the 1800's** could be used to remove rocks from rivers. These two pictures show a rock being attached to a diving bell and then raised to the surface. Diving bells are open at the bottom. The air pressure within the bell keeps the water out.





**A division problem** on the blackboard tests a student's knowledge of one of the most basic processes of mathematics.

**Division** is a way of separating a group of things into equal parts. Suppose you have 18 marbles and you want to share the marbles with two friends. You want each of you to end up with the same number of marbles. To find out how many marbles each of you would get, you can count out the marbles into three equal groups. Each group has six marbles. So each of you would get six marbles as shown below. Separating a group of 18



things into three equal parts of 6 things is an example of division.

Division is one of the four basic operations in arithmetic. The others are addition, subtraction, and multiplication. You must learn how to add, subtract, and multiply before you begin to study division.

### Learning to divide

Once people learned division only by memorizing. Most teachers now agree that the best way to learn division is by understanding. You can learn to understand division without much difficulty.

### Division terms

**Dividend.** In  $32 \div 8 = 4$ , 32 is the dividend.

**Division fact** is a division in which the divisor and quotient are whole numbers not larger than 9. For example,  $42 \div 7 = 6$  is a division fact.

**Divisor.** In  $32 \div 8 = 4$ , 8 is the divisor.

**Long division** is a method of dividing numbers in which the work is written out.

**Quotient.** In  $32 \div 8 = 4$ , 4 is the quotient.

**Remainder** is any amount left over after a division operation has been completed. The remainder is always less than the divisor.

**Short division** is a method of dividing numbers in which much of the work is done mentally.

**Writing division.** One way of separating a group into equal parts is by counting it out into equal parts. But there is a much easier way to divide. To find how many groups of 3 there are in 12, you can subtract 3 from 12 until nothing is left:

$$\begin{array}{r} 12 \\ -3 \\ \hline 9 \end{array} \rightarrow \begin{array}{r} 9 \\ -3 \\ \hline 6 \end{array} \rightarrow \begin{array}{r} 6 \\ -3 \\ \hline 3 \end{array} \rightarrow \begin{array}{r} 3 \\ -3 \\ \hline 0 \end{array}$$

This shows that there are four 3's in 12.

Each basic operation in arithmetic is indicated by a special symbol. The symbol for division is  $\div$ . The statement  $12 \div 3 = 4$  means that when 12 things are separated into groups of three, there are four such groups. Or, that there are four 3's in 12. It can also mean that when 12 things are separated into three equal groups, there are four things in each group. People who know division usually read  $12 \div 3 = 4$  as "12 divided by 3 is 4." A problem in division also may be written this way:

$$\begin{array}{r} 4 \\ 3 \overline{)12} \end{array}$$

The parts of a division problem have special names. The number being divided is called the *dividend*. The number by which the dividend is divided is the *divisor*. The answer, or result, of the division is the *quotient*.

$$\begin{array}{ccc} & 4 & \text{Quotient} \\ \text{Divisor} & \rightarrow & 3 \overline{)12} \leftarrow \text{Dividend} \end{array}$$

Another way of writing a problem in division is the form used in writing fractions (see Fraction):

$$\frac{12}{3} = 4$$

**Division facts.** By using subtraction, you discovered that there are three equal groups of 4 things in a group of 12. Or,  $12 \div 3 = 4$ . This is a *division fact*. You can find all the division facts by using subtraction.

### The 64 division facts

2	3	4	5	6	7	8	9
$2/4$	$2/6$	$2/8$	$2/10$	$2/12$	$2/14$	$2/16$	$2/18$
3	4	5	6	7	8	9	
$3/6$	$3/9$	$3/12$	$3/15$	$3/18$	$3/21$	$3/24$	$3/27$
4	5	6	7	8	9		
$4/8$	$4/12$	$4/16$	$4/20$	$4/24$	$4/28$	$4/32$	$4/36$
5	6	7	8	9			
$5/10$	$5/15$	$5/20$	$5/25$	$5/30$	$5/35$	$5/40$	$5/45$
6	7	8	9				
$6/12$	$6/18$	$6/24$	$6/30$	$6/36$	$6/42$	$6/48$	$6/54$
7	8	9					
$7/14$	$7/21$	$7/28$	$7/35$	$7/42$	$7/49$	$7/56$	$7/63$
8	9						
$8/16$	$8/24$	$8/32$	$8/40$	$8/48$	$8/56$	$8/64$	$8/72$
9							
$9/18$	$9/27$	$9/36$	$9/45$	$9/54$	$9/63$	$9/72$	$9/81$



It is important to learn the division facts so well that you can use them automatically. The facts are useful themselves. They are also necessary in learning how to divide larger numbers quickly and accurately.

### Long division

*Long division* is a method that can be used to divide large numbers. In long division, you write out the work carefully.

Suppose you want to find out how many 3's there are in 79, or  $79 \div 3$ . Instead of subtracting one 3 at a time, you can shorten your work by subtracting several 3's at once. To begin, you might subtract five 3's, or 15, each time:

$$\begin{array}{r} 79 \\ -15 \\ \hline 64 \end{array} \rightarrow \begin{array}{r} 64 \\ -15 \\ \hline 49 \end{array} \rightarrow \begin{array}{r} 49 \\ -15 \\ \hline 34 \end{array} \rightarrow \begin{array}{r} 34 \\ -15 \\ \hline 19 \end{array} \rightarrow \begin{array}{r} 19 \\ -15 \\ \hline 4 \end{array} \rightarrow \begin{array}{r} 4 \\ -3 \\ \hline 1 \end{array}$$

All together, you subtracted  $5 + 5 + 5 + 5 + 5$  or twenty-five 3's from 79, leaving 4. You cannot subtract five more 3's, but you can subtract one more 3, leaving a *remainder* of 1. Thus, there are  $25 + 1$  or twenty-six 3's in 79 with 1 left over.

Subtracting five 3's at a time shortened your work. Next, you might try subtracting ten 3's, or 30, each time:

$$\begin{array}{r} 79 \\ -30 \\ \hline 49 \end{array} \rightarrow \begin{array}{r} 49 \\ -30 \\ \hline 19 \end{array} \rightarrow \begin{array}{r} 19 \\ -15 \\ \hline 4 \end{array} \rightarrow \begin{array}{r} 4 \\ -3 \\ \hline 1 \end{array}$$

This time, you subtracted  $10 + 10 + 5 + 1$  or twenty-six 3's from 79, and had 1 left as a remainder. A better form to use is this:

$$\begin{array}{r} 3\overline{)79} \\ -30 \\ \hline 49 \\ -30 \\ \hline 19 \\ -15 \\ \hline 4 \\ -3 \\ \hline 1 \end{array} \quad \begin{array}{l} 10 \text{ The number of 3's} \\ 10 \text{ subtracted are re-} \\ 5 \text{ corded in this column.} \\ 1 \end{array}$$

Remainder  $\rightarrow 1$       26      The total number of 3's subtracted.

After some practice, you might subtract twenty 3's and then six 3's:

$$\begin{array}{r} 26 \\ 3\overline{)79} \\ -60 \\ \hline 19 \\ -18 \\ \hline 1 \end{array} \quad \begin{array}{l} \leftarrow \text{The result is written} \\ 20 \text{ above the dividend} \\ 6 \text{ to complete the form.} \end{array}$$

To gain further practice in long division, you might now try to find out how many 21's there are in 891, or  $891 \div 21$ . First, you must decide how many 21's you will subtract at a time. Ten 21's, or 210, might prove to be

useful. Using 10's, 100's, or 1,000's in multiplying the divisor makes division much easier.

$$\begin{array}{r} 42 \\ 21\overline{)891} \\ -210 \\ \hline 681 \\ -210 \\ \hline 471 \\ -210 \\ \hline 261 \\ -210 \\ \hline 51 \\ -21 \\ \hline 30 \\ -21 \\ \hline 9 \end{array} \quad \begin{array}{l} 10 \text{ Number of 21's} \\ 10 \text{ subtracted.} \\ 10 \\ 10 \\ 1 \end{array}$$

Remainder  $\rightarrow 9$       42

When you have subtracted four 210's or forty 21's, you find that the remainder, 51, is too small to subtract ten more 21's. You can, however, subtract one 21 at a time. This finally gives you  $10 + 10 + 10 + 10 + 1 + 1$  or forty-two 21's in 891, with a remainder of 9.

You could have used twenty 21's, or 420, as your first unit.

$$\begin{array}{r} 42 \\ 21\overline{)891} \\ -420 \\ \hline 471 \\ -420 \\ \hline 51 \\ -42 \\ \hline 9 \end{array} \quad \begin{array}{l} 20 \text{ Number of 21's} \\ 20 \text{ subtracted.} \\ 2 \end{array}$$

Remainder  $\rightarrow 9$       42

One last example will illustrate further the process of long division. Suppose you want to know how many 37's there are in 12,526, or  $12,526 \div 37$ . Once again you must decide how many 37's to subtract at one time.

$$\begin{array}{r} 338 \\ 37\overline{)12526} \\ -7400 \\ \hline 5126 \\ -3700 \\ \hline 1426 \\ -1110 \\ \hline 316 \\ -185 \\ \hline 131 \\ -111 \\ \hline 20 \end{array} \quad \begin{array}{l} 200 \text{ Number of 37's} \\ 100 \text{ subtracted.} \\ 30 \\ 5 \\ 3 \end{array}$$

Remainder  $\rightarrow 20$       338

You may have to experiment on a sheet of scrap paper to find the units that you can use to solve the problem easily. You can use even larger units than 200.

$$\begin{array}{r} 338 \\ 37\overline{)12526} \\ -11100 \\ \hline 1426 \\ -1110 \\ \hline 316 \\ -296 \\ \hline 20 \end{array} \quad \begin{array}{l} 300 \text{ Number of 37's} \\ 30 \text{ subtracted.} \\ 8 \end{array}$$

Remainder  $\rightarrow 20$       338



Many persons use a form for long division even shorter than those outlined above. The three steps look like this:

$$\begin{array}{r}
 3 \\
 37 \overline{)12526} \\
 \underline{111} \phantom{00} \\
 14 \phantom{00}
 \end{array}
 \quad \rightarrow \quad
 \begin{array}{r}
 33 \\
 37 \overline{)12526} \\
 \underline{111} \phantom{00} \\
 142 \phantom{00} \\
 \underline{111} \phantom{00} \\
 31 \phantom{00}
 \end{array}
 \quad \rightarrow \quad
 \begin{array}{r}
 338 \\
 37 \overline{)12526} \\
 \underline{111} \phantom{00} \\
 142 \phantom{00} \\
 \underline{111} \phantom{00} \\
 316 \phantom{00} \\
 \underline{296} \phantom{00} \\
 20
 \end{array}$$

This form does the same things that have been discussed above, but by a different method. It does not illustrate the process so well to a beginner.

When using this shorter form, it helps to notice that in all these examples you write the answer (quotient) above the proper places in the dividend. That is, when you subtract a number of 100's, you record the number of 100's above the 100's place in the dividend.

**Remainders in division.** There is often a remainder when you have completed a problem in division. What you do with this remainder depends on the kind of problem. If you want to know how many 3's there are in 79, you might have had 79 cents to spend on three-cent postage stamps. You would find that you could buy 26 stamps and have 1 cent left.

If you wanted to share 79 apples among three persons, you would also find that there are twenty-six 3's in 79 and a remainder of 1. This means that each person gets 26 apples and there is one left to share. If the sharing is to be absolutely equal, you would have to cut the remaining apple into three equal parts. Each person would receive  $26\frac{1}{3}$  apples.

These examples show that what is done to a remainder depends on the problem. In some cases, further division into fractional parts is indicated. In other cases, the remainder merely tells how many are "left over."

**Division of decimal fractions.** You can also use long division to divide numbers that include decimal fractions. The statement  $78.35 \div 3.6$  is this kind of problem. In order to understand division of decimal fractions, you must learn an interesting feature of division.

You know that  $15 \div 3 = 5$  is a division fact. What would happen if both the 15 and 3 were multiplied by 10? That is, what is the result of dividing 150 by 30? Long division will show you that this quotient is also 5. Thus,  $15 \div 3 = 5$ , and  $150 \div 30 = 5$ . Similarly,  $72 \div 6 = 12$  and  $720 \div 60 = 12$ . If the 72 and 6 are multiplied by 100, the quotient of  $7,200 \div 600$  is also 12. These examples illustrate a general rule: *multiplying both the dividend and divisor by 10, 100, 1,000, or any other nonzero number, does not change the quotient.*

This rule can be used to divide 78.35 by 3.6. Both 78.35 and 3.6 can be multiplied by 10. Thus,  $78.35 \times 10 = 783.5$  and  $3.6 \times 10 = 36$ . The quotient of  $783.5 \div 36$  will be the same as the quotient of  $78.35 \div 3.6$ . But the decimal points now have new positions. A useful device is to use a caret mark (^) to indicate the new position of the decimal points. The decimal point in the quotient will appear directly above the caret mark in the dividend.

$$3.6 \wedge \overline{)78.3 \wedge 5}$$

This shows that 78.35 and 3.6 have both been multiplied by 10. Sometimes it is necessary to multiply the dividend and divisor by 100, 1,000, or some larger multiple of 10. For example,  $25.773 \div 17.94$  should be multiplied by 100:

$$17.94 \wedge \overline{)25.77 \wedge 3}$$

You should multiply the dividend and divisor by a multiple of 10 large enough to change the divisor into a whole number, or a number that does not include a decimal fraction.

For every division problem with a remainder of zero, there is a corresponding multiplication problem. The two numbers that are multiplied are the quotient and divisor in the division problem. For example:

$$\begin{aligned}
 3.25 \div 1.3 &= 2.5 \\
 1.3 \times 2.5 &= 3.25
 \end{aligned}$$

Experience with such problems has resulted in two rules. In multiplication, the number of decimal places in the *product* (answer to the multiplication problem) is the sum of the number of decimal places in the numbers that were multiplied. In division, the number of decimal places in the quotient is the number of decimal places in the dividend minus the number of decimal places in the divisor. If the divisor is a whole number, you can ignore the decimal point in the dividend while you are working the problem. When you get a number for the quotient, put as many decimal places in the quotient as there are in the dividend. Because the divisor has no decimal places, none must be subtracted from the number in the dividend.

In division problems, you often have to find the quotient to the nearest tenth, hundredth, and so on. You can do this easily. After you have placed the caret marks in the divisor and dividend, use just as many digits to the right of the dividend's caret mark as the number of decimal places wanted in the answer. Sometimes it is necessary to add zeros to the dividend. For example, you must first change  $3.6 \overline{)78.35}$  to  $3.6 \wedge \overline{)78.3 \wedge 5}$  to make the divisor a whole number. Suppose the quotient must be correct to the nearest hundredth. Then you must add a zero to the dividend, making it  $78.3 \wedge 50$ .

$$\begin{array}{r}
 21.76 \\
 3.6 \wedge \overline{)78.3 \wedge 50} \\
 \underline{-72000} \phantom{00} \\
 6350 \phantom{00} \\
 \underline{-3600} \phantom{00} \\
 2750 \phantom{00} \\
 \underline{-2520} \phantom{00} \\
 230 \phantom{00} \\
 \underline{-216} \phantom{00} \\
 14
 \end{array}
 \quad
 \begin{array}{r}
 2000 \\
 100 \\
 10 \\
 6 \\
 2176
 \end{array}$$

You do not have to do anything with the remainder, because the problem asked you to be accurate only to the nearest hundredth. If the remainder is more than half of the divisor, then the digit in the divisor that is farthest to the right is increased by one. When the remainder is exactly half of the divisor, it is common to add one to the rightmost digit of the divisor if doing so will make it an



*even number* (number that can be divided by two without a remainder).

### Short division

When dividing by a one-digit number such as 7, you can do some of the work in long division without writing it down. Division of this kind, which is usually done in the mind rather than on paper, is called *short division*. The method is the same as in long division, but you do the work mentally.

#### Long Division

$$\begin{array}{r} 212 \\ 4 \overline{)849} \\ \underline{-800} \\ 49 \\ \underline{-40} \\ 9 \\ \underline{-8} \\ 1 \end{array}$$

#### Short Division

$$\begin{array}{r} 212 \text{ R(remainder) } 1 \\ 4 \overline{)849} \end{array}$$

The only difference between these two examples is that in short division you do the work mentally and indicate the remainder next to the quotient. The letter *R* is often used to mean *Remainder*. In this example, you first see that you can subtract two hundred 4's from 849. You write the 2 in the 100's place over the 8 in the dividend. Next, you can subtract ten 4's from the remaining 49. You write the 1 in the 10's place over the 4 in the dividend. Finally, you can subtract two 4's from the remaining 9. You write the 2 in the 1's place over the 9 in the dividend. You show the remainder to the right of the quotient.

In more difficult problems in short division, you must use a new device. The problem  $415 \div 7$  will show this.

$$\begin{array}{r} 5 \\ 7 \overline{)415} \end{array}$$

In solving this problem, your first step is to subtract fifty 7's or 350, which is thirty-five 10's. Write the 5 (for 50 or five 10's) over the 1 in the dividend. You do the subtraction mentally. Thirty-five 10's subtracted from forty-one 10's is six 10's. You write a little 6 to the left of the 5 in the dividend.

$$\begin{array}{r} 5 \\ 7 \overline{)41^65} \end{array}$$

Now you are dividing six 10's and 5, or 65, by 7. You can subtract nine 7's or 63 from 65, leaving a remainder of 2.

$$\begin{array}{r} 59 \\ 7 \overline{)41^65} \end{array} \quad \text{R } 2 \quad \text{or } 59\frac{2}{7}$$

It is useful to see how this process is derived from long division.

$$\begin{array}{r} 59 \\ 7 \overline{)415} \\ \underline{-350} \\ 65 \\ \underline{-63} \\ 2 \end{array}$$

50  
9  
R 2

Another example is  $7,536 \div 9$ . As in the case of long division, you must decide how many 9's you can subtract at one time.

$$\begin{array}{r} 837 \\ 9 \overline{)7536} \end{array} \quad \text{R } 3 \quad \text{or } 837\frac{3}{9} \text{ or } 837\frac{1}{3}$$

First, you subtract eight hundred 9's, or 720. You write the 8 (for eight 100's or 800) over the 5 in the dividend. Mentally you subtract 72 (hundreds) from 75 (hundreds):  $75 - 72 = 3$ . You write a little 3 to the left of the 3 in the dividend to keep the three 100's in the work. From this new figure of 336, you can subtract thirty 9's or 270. You write the 3 for the thirty 9's over the 3 in the dividend. Next,  $33 - 27 = 6$ . You write a little 6 to the left of the 6 in the dividend to keep the six 10's in the work. From this new figure of 66, you can subtract seven 9's, or 63. You write the 7 for the seven 9's over the 6 in the dividend. Finally,  $66 - 63 = 3$ . You indicate the remainder of 3 to the right of the quotient. After you have had some practice, you will be able to leave out the little numbers as reminders of figures that must be included in the work. You will soon be able to remember these numbers in your head.

### How to check division

You will be wise to check the answer to a division problem to be sure you have solved it correctly.

**Rounding off.** One way to check is to see whether or not the quotient is a sensible answer. You can estimate a quotient by rounding off the dividend and divisor. To estimate the quotient of  $158 \div 76$ , you can round off 158 to 160 and 76 to 80. Because  $160 \div 80 = 2$ , the quotient of  $158 \div 76$  should be about 2. To estimate the quotient of  $5,124 \div 36$ , you can round off 5,124 to 5,000 and 36 to 50. You can see that  $5,000 \div 50 = 100$ , and  $5,000 \div 25 = 200$ . Thus, the quotient of  $5,124 \div 36$  should be somewhere between 100 and 200. Estimating the quotient will help you decide whether your answer is sensible.

**Checking by multiplication.** Another way of checking a quotient is to multiply the quotient by the divisor to see if the product is the dividend. If you have multiplied correctly, this method will catch any error. This is because multiplication is the opposite of division.

$$\begin{array}{r} 13 \\ 24 \overline{)312} \\ \underline{\times 24} \\ 52 \\ \underline{26} \\ 312 \end{array}$$

The next example shows how to use the remainder in checking by multiplication:

$$\begin{array}{r} 42 \\ 21 \overline{)889} \end{array} \quad \text{R } 7$$

$$\begin{array}{r} 42 \\ \times 21 \\ \hline 84 \\ 882 \\ \hline 882 \\ + 7 \\ \hline 889 \end{array}$$

R



The quotient is multiplied by the divisor, and the remainder is added to the product.

### Four key division ideas

Here are four important rules to remember for solving division problems.

1. Remember that division means breaking up a number into smaller equal groups. The divisor can show the size of these groups or the number of groups.

2. Learn the division facts so well that you do not have to stop and figure them out each time. You will use the division facts constantly in everyday arithmetic, and will need to know them when you have to divide larger numbers.

3. Remember the method for dividing larger numbers used in long division. In long division, subtract the divisor from the dividend as many times as possible in a single step. In this way, you can reduce the number of steps in long division.

4. Always check the answer after finishing a division problem. You can do this by estimating or by multiplying the quotient by the divisor and adding any remainder.

**Related articles** in *World Book* include:

Algebra (Division)  
Arithmetic  
Decimal system

Fraction  
Multiplication  
Subtraction

### Practice division examples

- |                       |                          |                             |
|-----------------------|--------------------------|-----------------------------|
| 1. $4\overline{)56}$  | 6. $2\overline{)1146}$   | 11. $326\overline{)10457}$  |
| 2. $7\overline{)105}$ | 7. $3\overline{)1008}$   | 12. $29\overline{)1201}$    |
| 3. $5\overline{)625}$ | 8. $8\overline{)984}$    | 13. $3.14\overline{)25.60}$ |
| 4. $6\overline{)522}$ | 9. $23\overline{)483}$   | 14. $.06\overline{)9.87}$   |
| 5. $9\overline{)387}$ | 10. $47\overline{)6281}$ | 15. $1.26\overline{)00882}$ |

16. Miss Smith's class at school is going to visit the local newspaper. Some of the mothers have offered to drive. There are 35 children in the class, and each car can take 5 children. How many cars will be needed for the trip?

17. There are 7 days in a week. How many weeks are there in one year (365 days)?

18. A certain kind of chocolate bar costs 13 pence each. How many of these chocolate bars can Sue buy with 91 pence?

19. Four boys wish to share equally 64 pieces of chocolate. How many pieces should each boy get?

20. Tom rides his bicycle at a speed of 6 kilometres an hour. At this rate, how many hours will it take him to ride 15 kilometres?

21. An aeroplane travels at the rate of 560 kilometres an hour. How long will it take to fly 1,260 kilometres?

22. Bill and his father went on a trip in their car. They travelled 613.9 kilometres in 10 hours, 18 minutes. What was their average speed?

23. Mary's mother rents a flat for £2,520 a year. How much rent would she have to pay for one month?

### Answers to the division examples

- |        |              |              |                          |
|--------|--------------|--------------|--------------------------|
| 1. 14  | 7. 336       | 13. 8.15     | 18. 7 bars               |
| 2. 15  | 8. 123       | 14. 164.5    | 19. 16 pieces            |
| 3. 125 | 9. 21        | 15. .007     | 20. $2\frac{1}{2}$ hours |
| 4. 87  | 10. 133 R 30 | 16. 7 cars   | 21. $2\frac{1}{4}$ hours |
| 5. 43  | 11. 32 R 25  | 17. 52 weeks | 22. 59.6 kph             |
| 6. 573 | 12. 41 R 12  | and 1 day    | 23. £210                 |

**Divorce** is the legal ending of a marriage. The laws of most nations permit divorce only under certain circumstances. Divorce is restricted chiefly because it breaks up a family, the basic unit of society. Some countries, including Ireland and the Philippines, where Roman Catholicism is the dominant religion, prohibit divorce.

Most men and women who seek a divorce do so because they cannot solve certain problems in their marriage. Such problems may include differences in goals, financial difficulties, or a poor sexual relationship.

A person seeking a divorce generally must appear in court to explain why he or she wants to end the marriage. A judge then decides whether to grant a divorce. In certain straightforward cases, it may be possible to obtain a divorce without having to appear in court. But there must still be grounds for the divorce and the court has to ratify the proceedings. A divorced person may remarry.

Divorce differs from *annulment*, in which a court declares that a marriage has been invalid from its beginning. A person whose marriage has been annulled may remarry. Divorce also differs from *legal separation*, in which a court authorizes a husband and wife to live apart. *Spouses* (a husband and wife) who are legally separated may not remarry.

Divorce often affects young children deeply. But many experts believe that living with one parent is less harmful to a child than living with both parents in an unhappy environment. Many divorced men and women remarry, and many such marriages are successful. However, second marriages present special problems of adjustment, especially for couples who have children from a former marriage. Families that include children from one or more previous marriages are called *step-families*. Stepfamilies and single parent families have become more common as the divorce rate rises.

### Grounds for divorce

Modern divorce laws have developed from the religious rules of the society concerned. For example, in countries such as Australia, Canada, New Zealand, the United Kingdom, and the United States, the law was based on a Christian tradition. In these countries, until the mid-1900s, divorce was available only to an "innocent" party. Grounds for divorce would be a fault or "matrimonial offence" committed by the other spouse. Examples were adultery, desertion, or cruelty. In many cases, divorces were contested and both parties might allege the other was guilty. This form of divorce led to many lengthy cases with both spouses making unpleasant allegations and usually incurring much expense.

During the 1960's, many people campaigned for a more liberal approach to divorce because they believed that the fault did not necessarily lie with just one spouse and it was pointless to maintain a marriage that would never succeed. The ground for divorce in Australia, New Zealand, and the UK now is simply an irretrievable or irreconcilable breakdown of the marriage. This ground can be shown by the spouses living apart for a certain number of years. But in the UK other reasons, similar to the old grounds, may also be used to show the marriage has broken down.

Sometimes the spouses are expected to receive counselling before the divorce procedure begins, to see



whether a reconciliation can be achieved. In many countries the courts dealing with divorce have been renamed *family courts* and deal with all proceedings relating to marriage, children, and family issues.

In India, most people follow the Hindu religion, which traditionally does not allow divorce. But since 1956, there has been a law which governs divorce for Hindus. Under the *sharia*, Islamic law governing the everyday lives of Muslims, a man may divorce his wife simply by repeating the word *talaq* (divorce) three times. The other religious groups such as Christian, Sikh, Parsee, and Jewish communities, are also governed by their personal religious laws. There is also a secular law governing divorce.

### Divorce provisions

A husband and wife planning a divorce must make arrangements for child custody and support, division of their property, and maintaining one's spouse, if necessary. They may reach agreement on these arrangements through their lawyers. If the judge considers the agreement fair, the judge approves it. If the spouses cannot agree, the judge decides the arrangements.

**Financial arrangements.** In the past, the judge ordered many divorced men to pay considerable *alimony* (sums of money) to maintain their ex-wives. They also had to give up some of their property and bear most of the responsibility for supporting their children. There were two chief reasons for this situation. First, large numbers of divorced women had no job outside the home and needed money to support themselves and their children. Second, traditional fault laws provided that the "guilty" spouse could not receive alimony. In many cases, the husband was the legally guilty spouse because his wife sued for the divorce, even though both might have wanted it.

Today, courts base their decisions on financial arrangements, primarily on the financial condition of each spouse. Judges realize that many women have the qualifications to work outside the home and need not be fully supported by their former husband. Therefore, if both spouses can earn enough income to support themselves, the court may order that no maintenance be paid. If the wife has a higher income than her husband, she may have to pay maintenance to him. In addition, the parents may share responsibility for child support. The court may also divide a couple's property on the basis of financial circumstances.

**Child custody arrangements.** In the early and mid-1900's, judges granted custody of the children to the wife almost automatically in the majority of divorce cases. They believed that children should not be separated from the mother. But today, many judges realize that some children might be better off living with the father. Therefore, the court may grant custody to either parent. The judge also determines each parent's rights to visit the children. This right is known as *access*. The judge may take into account which parent the child would prefer to live with and will usually keep all children of a marriage together.

Some divorced parents return to court several times because one or both of them wants to challenge the child custody decision. If the court changes its decision, the children may have to leave the home of one parent

and move in with the other. Such a move can harm children emotionally. As a result, some courts have become reluctant to move children unless they are in danger.

The rate of divorce has increased dramatically since the 1960's. Experts have suggested many reasons for the increase. (1) Divorce is more socially acceptable than ever before. (2) Many people expect more of marriage than earlier generations did, and so they may be more easily disappointed. (3) More high-paying jobs are open to women. These opportunities have made wives less dependent economically on their husbands than women used to be. (4) Changes in divorce laws have made divorce easier to obtain.

**Related articles in *World Book* include:**

Abandonment  
Alienation

Marriage

**Dixie**, also called Dixieland, is a name often given to the southern part of the United States. There are different explanations for this name. A Louisiana bank once printed 10-dollar bills bearing the French word *dix*, which means *ten*. According to one story, people called Louisiana "Dix's Land," and then shortened it to Dixie. In time, *Dixie* came to mean the entire South. In another story, the name came from a slaveowner named Dixie, or Dixy.

**Dixie** is the name of a famous song especially popular in the southern parts of the United States. Daniel Emmett, member of a minstrel-show company, wrote the song in 1859 in New York City. The song became an immediate hit. Many publishers printed their own versions. The original first stanza was:

I wish I was in de land ob cotton,  
Old times dar am not forgotten,  
Look away! Look away! Look away! Dixie Land.

When Abraham Lincoln ran for the presidency in 1860, "Dixie" was used as a campaign song against him. Five years later, toward the end of the American Civil War, he asked a band at the White House to play "Dixie." **Dixon, Joseph** (1799-1869), was an American inventor and manufacturer. He founded a factory to make lead pencils and stove polish from graphite at Salem, Massachusetts, in 1827. In 1832, he patented a process of using coloured inks to prevent counterfeiting. Dixon patented and introduced graphite crucibles for making pottery and steel. He was born in Marblehead, Massachusetts. **Dixon, Sir Owen** (1886-1973), an Australian lawyer, was a justice of the High Court of Australia from 1929 to 1952, and chief justice from 1952 to 1964. He was the Australian minister to Washington in the United States during part of World War II, from 1942 to 1944. In 1950, he served as a special mediator for the United Nations in the Kashmir dispute between India and Pakistan. He was born and educated in Melbourne.

**Dizziness** is a condition in which people feel that their surroundings are whirling about, or that they are falling. This type of dizziness is called *vertigo*. Another type of dizziness is characterized by light-headedness, the sensation that comes before fainting. It causes a person to stagger or fall. Often there is nausea and vomiting. Brief periods during which there is a reduced flow of blood to the brain may cause dizziness. It may also be caused by changes in the pressure of the fluid in the semicircular canals of the inner ear. Dizziness often accompanies



The map illustrates the geographical context of Djibouti. It is bordered by Ethiopia to the west and north, Eritrea to the north and east, and Somalia to the south and east. The Red Sea is located to the northeast, and the Gulf of Aden is to the south. Key features include Lake Assal, Lake Abaya, and Lake Abbe. Major cities and towns are marked, including Djibouti, Mousaïti, Dorn, Balho, and Arta. The map also shows the Red Sea to the east and the Gulf of Aden to the south. A scale bar at the bottom indicates distances in miles and kilometers.



## Facts in brief about Djibouti

**Capital:** Djibouti (city).

**Official language:** Arabic.

**Area:** 23,200 km<sup>2</sup>. *Greatest distances*—east-west, 177 km; north-south, 201 km. *Coastline*—245 km.

**Elevation:** *Highest*—Mousaalli, 2,063 m above sea level.

*Lowest*—Lake Assal, 155 m below sea level.

**Population:** *Estimated 1996 population*—526,000; density, 23 people per km<sup>2</sup>; distribution, 83 per cent urban, 17 per cent rural. *1970 census*—163,500. *Estimated 2001 population*—608,000.

**Chief products:** Hides, skins.

**Flag:** The flag has a blue horizontal stripe at the top, a green horizontal stripe at the bottom, and a red star on a white triangle near the staff. Adopted in 1977. See **Flag** (picture: Flags of Africa).

**Money:** *Currency unit*—Djibouti franc.

several peaks that rise more than 1,500 metres above sea level. A rugged plateau lies beyond the mountains. Vegetation is scarce throughout the country.

Djibouti, which has been called "a valley of hell," has one of the hottest and driest climates in the world. The temperature averages 29 °C, and it sometimes rises above 42 °C from May to October. The country receives less than 13 centimetres of rain annually.

**Economy.** Djibouti is an extremely poor and underdeveloped country. It has no natural resources of any importance and no industry except for two soft-drink plants. Djibouti's only agricultural activity is livestock herding. The nation's economy is based almost entirely on the port of the capital and a railway that links it with Addis Ababa, Ethiopia. Djibouti serves as a major port for Ethiopian trade. The country has a good harbour and an international airport.

**History.** People have lived in what is now Djibouti since prehistoric times. During the A.D. 800's, missionaries from Arabia converted the Afars who inhabited the area to Islam. The Afars then established several Islamic

states, which fought a series of wars with Christian Ethiopia from the 1200's to the early 1600's. By the 1800's, the Issas had taken over much of the Afars' grazing lands, and hostility between the two groups was growing.

France purchased the Afar port of Obock in 1862 and established a coaling station for French ships there in 1881. The French signed agreements in 1884 with the Afar sultans of Obock and nearby Tadjoura. In 1888, the French occupied the uninhabited area that eventually became the city of Djibouti. They then united various small possessions in the area into a single territory and named it French Somaliland.

The French developed good relations with Emperor Menelik II of Ethiopia, who decided to have a railway built from his capital, Addis Ababa, to the city of Djibouti. In 1897, he made Djibouti the official port for Ethiopian trade. The city grew rapidly, but little development occurred elsewhere in the territory.

After World War II ended in 1945, the Issas and some other groups in French Somaliland began to demand independence from France. However, the French kept these groups under control. Against the opposition of the Issas, the territory voted in 1958 to join the French Community. This organization is an economic and cultural association that links France and its territories.

In 1967, French Somaliland voted to continue its association with France and was renamed the French Territory of the Afars and Issas. But opposition to French rule grew during the 1970's, when the Issa population increased rapidly. In May 1977, the people voted overwhelmingly for independence. The territory became the independent nation of Djibouti on June 27, 1977. Hostility between the Afars and the Issas has continued since independence. Beginning in 1991, government forces, which are dominated by Issas, have fought rebel Afar guerrillas.

See also **Djibouti** (city).

**Djibouti** (pop. 317,000) is the capital of Djibouti, a country in eastern Africa. More than half of the nation's people live in the city of Djibouti. The city lies on the Gulf of Aden and has one of the best ports on the eastern coast of Africa (see **Djibouti** [map]). A railway connects Djibouti with Addis Ababa, the capital of Ethiopia. Djibouti is a trading port for Ethiopia.

In 1888, France took control of the Djibouti area, which was then uninhabited. The French founded the city that same year. In 1896, they made it the capital of French Somaliland (now the country of Djibouti). The French developed the city as a well-planned colonial capital with many fine public and commercial buildings. The population of Djibouti has grown rapidly since 1945, and large slums have developed in some areas.

**Djilas, Milovan.** See Yugoslavia (Communist rule).

**DNA.** See Nucleic acid; Heredity (The chemical basis of heredity); Cell (The nucleus; The 1900's; The code of life).

**DNA fingerprinting,** also known as *DNA profiling*, is a technique used to identify criminals through the analysis of genetic material. The technique is also used to settle *paternity* disputes—that is, to determine the biological father of a child. The genetic material used in DNA fingerprinting, called *deoxyribonucleic acid* (DNA), is found in most cells. The technique is based on the theory that it is extremely unlikely that two people would possess identical DNA.



The city of Djibouti has many fine public and commercial buildings, built during the colonial days by the French.



DNA fingerprinting is used to analyse DNA found in such biological materials as blood, semen, bone, and hair. The most common type of DNA fingerprinting is called *restriction fragment length polymorphism* (RFLP). In RFLP, DNA is extracted from biological material found at the scene of a crime. Technicians use a chemical called a *restriction enzyme* to divide the DNA into fragments. The fragments are then separated according to size by a laboratory technique called *electrophoresis* (see **Electrophoresis**). The separated fragments form a pattern of dozens of parallel bands that reflect the composition of the DNA. In principle, the pattern produced will always be the same for the same person. It is estimated that there are more than 10 billion billion, or  $10^{19}$ , possible patterns. Thus, many experts believe it is virtually impossible that the DNA pattern of one person would match that of another.

In 1995, the United Kingdom established the world's first national database of DNA records. Some critics of DNA fingerprinting believe that the technique is not yet reliable enough to be used as evidence in a court of law.

**Dnepr River** is one of the longest rivers in Europe. It is spelled *Dnyapro* in Belarus and *Dnipro* in Ukraine. The Dnepr flows through an important region. It rises in the Valdai Hills, near the city of Smolensk in Russia. It flows south for 2,285 kilometres through Russia, Belarus, and Ukraine. It empties into the Black Sea. Kiev, Ukraine's capital, lies on the river. The northern part of the Dnepr flows through a forested area, and the southern part through farmland and an industrialized region. The Dnepr drains an area of about 504,000 square kilometres. For location, see **Ukraine** (terrain map).

The construction of dams and reservoirs has deepened the Dnepr and removed obstacles caused by rapids. As a result, the river is navigable for most of its course. One of the largest dams is the Dneproges Dam (see **Dneproges Dam**). The Dnepr is an important route for the transportation of cargo, including coal and grain from Ukraine and timber from northern regions. Important tributaries of the Dnepr include the Berezina, Desna, Ingulets, Pripjat, and Psel rivers. A system of canals connects the Dnepr with several rivers that empty into the Baltic Sea.

**Dneproges Dam**, a large concrete dam in Ukraine, is located 320 kilometres from the mouth of the Dnepr River. It provides hydroelectric power for most of the mines and industries in the republic. The dam is 1,500 metres long and 61 metres high, and was completed in 1932. When the Germans invaded Ukraine in 1941, the Communists blew up the dam and the power plant. They were rebuilt. The dam holds back 1,220,000 cubic metres of water. Its power plant can generate 650,000 kilowatts of electricity.

See also **Ukraine**.

**Dnepropetrovsk** (pop. 1,140,000) is a major industrial city in Ukraine. It lies in east-central Ukraine, on the Dnepr River. For the location of Dnepropetrovsk, see **Ukraine** (map).

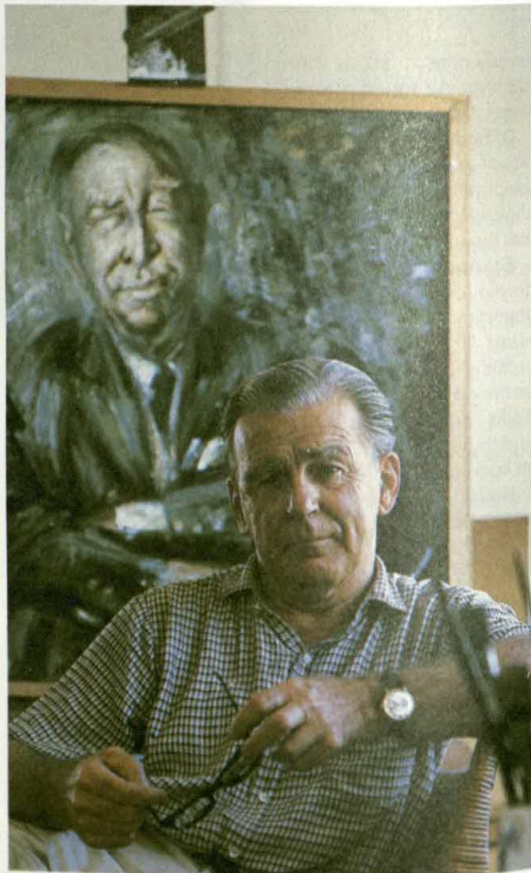
Dnepropetrovsk was founded by Prince Gregory Potemkin of Russia in 1776. At that time, the city was called Ekaterinoslav. It took its present name in 1926.

**Dnestr River**, spelled *Nistru* in Moldova and *Dnister* in Ukraine, rises in the Carpathian Mountains in western Ukraine. It flows southeast for 1,360 kilometres. It passes

through western Ukraine and then flows into Moldova. It continues through eastern Moldova and then southern Ukraine, where it empties into the Black Sea. Boats travel along the Dnestr between the Black Sea and Khotin, a city in western Ukraine.

**Dobell, Sir William** (1899-1970), an artist and Australia's greatest portrait painter, won the Archibald Prize three times—in 1943, in 1948, and in 1959. He was knighted in 1966.

Dobell was born in Newcastle, New South Wales. He won a scholarship to London in 1929 and did not return to Australia until 1939. In 1944, his prize-winning portrait of Joshua Smith provoked a lawsuit by two artists on the grounds that it was a caricature. Dobell, a shy man,



**William Dobell's portraits** caused controversy in the early 1940's. Later, most Australian critics acclaimed them.

found himself hailed as a hero of the modernist cause.

Dobell admired the work of such painters as Rembrandt, Edgar Degas, and Pierre Auguste Renoir. His portraits show his love of the colour brown. Like Renoir, he used his brush to model the limbs, faces, and bodies of his subjects in a rounded way but not in a sculptured fashion.

See also **Archibald Prize**.

**Doberman pinscher** is a breed of dog that originated in Germany. It is named after Louis Dobermann, a German dog breeder who first developed the dogs





A dock in a commercial harbour serves cargo ships that carry a wide variety of goods and raw materials. The ship shown above is taking on a load of cotton.

in the late 1800's. Dobermans make good guard and police dogs because of their courage, alertness, and intelligence. They are swift and strong, and their excellent sense of smell enables them to track people. With proper training, Dobermans make affectionate, loyal pets. Most Dobermans have a black coat with rust-coloured markings. Some have red, blue, or tan coats. They have short, smooth hair. Most of these dogs have *docked* (cropped) tails and clipped ears. The dogs stand 60 to 70 centimetres high and weigh from 25 to 34 kilograms.

**Dobie, J. Frank** (1888-1964), an American author and professor, became famous for his writings on the cul-

ture of Texas and the southwest of the United States. In 20 books and hundreds of articles, Dobie collected or retold stories about cowboys, longhorn cattle, and other people and animals of the range country.

James Frank Dobie was born on a ranch in Live Oak County, Texas. For most of the period from 1913 to 1947, he was an English professor at the University of Texas. For many years, Dobie served as secretary and editor of the Texas Folklore Society, which published several of his works. Dobie's first book was *A Vaquero of the Brush Country* (1929), which describes the experiences of a Texas cattleman during pioneer days. Dobie's other works include *Coronado's Children* (1930), *The Longhorns* (1941), *The Mustangs* (1952), and *Tales of Old-Time Texas* (1955).

**Dobson, Frank** (1888-1963), a British sculptor, became known for his sculptures of women. In these works, simple contours contrast with unusually heavy limbs. Dobson's bronze statue *Truth* stands in the Tate Gallery, in London.

Dobson was born in London. He was president of the London Group of Artists for many years. He was also professor of sculpture at the Royal College of Art, in London. He became a member of the Royal Academy in 1953.

**Dobson, Rosemary** (1920- ), a leading Australian poet, won the Patrick White Literary Award in 1984. Five collections of her poetry are combined in her *Selected Poems*, which was published in 1973. Critics have praised her poetry for its sophisticated comments on life and art. Her work has been widely translated. She was born in Sydney.

**Dobson fly.** See Hellgrammite.

**Dock** is the water beside a wharf or pier (or between two wharves or piers) in which a ship floats. The term



The Doberman pinscher is an intelligent watchdog.



*dock* is also used to mean a wharf or pier. The *wet dock* is a basin with gates to keep in or shut out water, and maintain the same water level while unloading and loading ships. Such docks are used in harbours where the tide rises and falls greatly.

See also **Dry dock**.

**Dock** is the name of several kinds of plants belonging to the buckwheat family. Three common perennial weeds belong to this family—*narrow-leaf*, or *yellow dock* (from the colour of the taproot); *sour dock*; and *broadleaf dock*. These weeds infest meadowland, gardens, lawns, and pastures, and are common wayside weeds. They grow from 60 to 120 centimetres high and have long, large leaves with wavy margins. Their thick, tapering roots are used medicinally for tonics, astringents, and skin remedies. The leaves of sour dock are eaten as potherbs, or greens, but they may poison animals that have a diet low in calcium. Dock may be controlled with amino triazole sprays.



Dock plant

See also **Buckwheat**.

**Scientific classification.** The dock plants belong to the buckwheat family, Polygonaceae. The narrow-leaf dock is *Rumex crispus*. The broadleaf dock is *R. obtusifolius*. The sour dock is *R. acetosa*.

**Doctor.** See Degree, College (The doctor's degree); Medicine (Providing medical care).

**Doctor Dolittle.** See Lofting, Hugh.

**Doctorfish**, one of the surgeonfishes, is a tropical marine fish, found in the East Indies. It is greyish-brown to yellow in colour with blue to grey fins. The fish gets its name because it has a sharp erectile spine in a little groove on each side of the body near the tail. This spine is shaped like a type of knife used by surgeons called a *lancet*.

**Scientific classification.** The doctorfish is a member of the surgeonfish family, Acanthuridae. It is *Acanthurus bahianus*.

**Documentary.** See Television.

**Dodder** is a destructive weed found over most of the world. It is called a *parasite* because it takes its food from other plants. The dodder grows from seed in the spring, then attaches itself by little suckers to some

nearby plant. The root and older part of the stem die, break off, and leave the dodder plant free. Dodder destroys much alfalfa, clover, and flax.

The stems of the dodder look like yellow, orange, white, and brown threads. The stems twine around other plants and sprawl from one plant to another, forming tangled masses. Dodder flowers are small and white, and they form in dense clusters.

**Scientific classification.** Dodder plants are members of the morning-glory family, Convolvulaceae. They make up the genus *Cuscuta*.

See also **Plant** (picture: How nongreen plants get their food).

**Dodecanese Islands** include about 40 Greek islands and many small reefs in the Aegean Sea. They lie off the southwest coast of Turkey. The islands cover 2,682 square kilometres and have a population of about 145,000. Many of the small islands and reefs are uninhabited. The most important islands are Kalimnos, Karpathos, Kos, Leros, Patmos, Rhodes, and Simi. The chief economic activities include tourism, fishing, sponge fishing, building small boats, farming, and rearing sheep and goats. The Dodecanese Islands came under Turkish rule in 1522. Italy took control in 1912 and held the islands until 1947, when they were given to Greece.

See also **Patmos**; **Rhodes**; **Greece** (map).

**Dodge, Mary Elizabeth Mapes** (1831-1905), an American author, wrote *Hans Brinker, or, The Silver Skates* (1865), a famous children's book about the Netherlands. Within 30 years the book had appeared in more than 100 editions and was translated into six languages. Dodge was recognized as a leader in the field of juvenile literature. She became editor of the American magazine *St. Nicholas* when it was organized in 1873, and persuaded the best authors of the time to contribute to the publication.

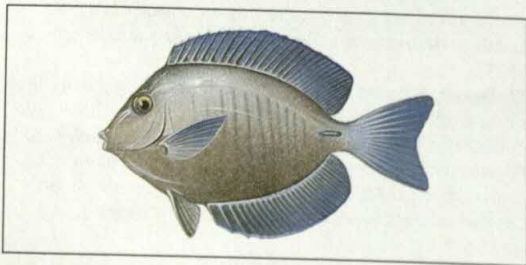
She was born in New York City, and grew up in a home that was a centre for literary groups. William Cullen Bryant and Horace Greeley were frequent visitors. Her husband died when she was 27, leaving her with two small sons. Because she had to support them, she returned to her father's home in Newark, New Jersey, and started her literary career.

**Dodge brothers** were two pioneers in car manufacturing. Both John Francis Dodge (1864-1920) and Horace Elgin Dodge (1868-1920) were born in Michigan, U.S.A.

The Dodge brothers began their business careers making bicycles. In 1901, they opened a machine shop in Detroit. The brothers built parts for the Olds Motor Works and Ford Motor Company.

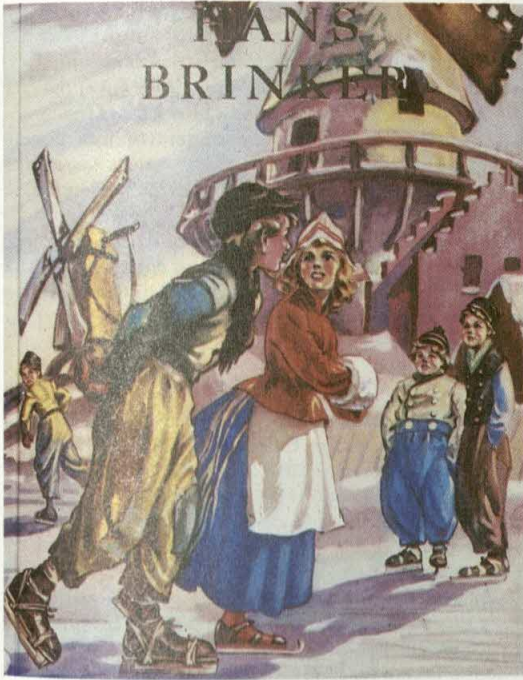
The Dodge brothers began making their own cars in 1914, and produced one of the first American cars with an all-steel body. Horace Dodge invented many improvements for cars, including an oven for baking enamel on steel bodies. The Dodge Company became part of Chrysler Corporation in 1928.

**Dodge City** (pop. 21,129) is a commercial centre in the state of Kansas in the United States. For location, see **United States of America** (political map). Dodge City was called the *Cowboy Capital of the World* and, at times, the *Wickedest Little City in the West* and *Queen of Cowntowns*. The city is the chief commercial centre of the region. It is also a leading beef-slaughtering and meat-packing centre.



The doctorfish lives in the tropical waters of the East Indies. It is greyish-brown to yellow and has blue to grey fins.





Mary Dodge's *Hans Brinker, or, The Silver Skates* tells about a Dutch boy, Hans, who competes in an ice skating race. This illustration shows Hans skating with the mayor's daughter.

Traders on the Santa Fe Trail travelled through the area in the 1800's. Dodge City was established when the Atchison, Topeka, and Santa Fe Railroad came in 1872. For about 10 years after 1875, it was the largest cattle market in the world. Many gunmen lived in Dodge City, and such famous peace officers as Wyatt Earp and Bat Masterson enforced the law. A restoration of Boot Hill and Front Street, the city's old main street, make up a popular tourist attraction. The name *Boot Hill* came from an early cemetery where cowboys and gunmen were buried still wearing their boots.

**Dodgson, Charles Lutwidge.** See Carroll, Lewis.

**Dodo** is an extinct flightless bird related to the pigeon. The dodo was about the size of a large turkey. It had short legs, an enormous beak, stubby wings, and a tuft-like tail with curly feathers. The dodo lived on the island of Mauritius in the Indian Ocean. It laid a single egg on the ground. Two related species called *solitaires* lived on nearby Reunion and Rodrigues islands.

European sailors killed the birds for food. Pigs and monkeys brought to the island by Portuguese sailors during the 1500's destroyed the eggs and ate the young. The dodo died out about 1680, the Reunion solitaire about 1750, and the Rodrigues solitaire about 1800. Several dodos, and possibly some solitaires, were exhibited alive in Europe and served as models for paintings. The heads and feet of a few dodos are preserved in museums, but the solitaires are known only from pictures, from accounts written by travellers, and from bones that were found on Reunion and Rodrigues islands.

**Scientific classification.** The dodo and solitaires belong to

the pigeon and dove order, Columbiformes. They are in the dodo and solitaire family, Raphidae. The dodo is *Raphus cuculatus*. The Reunion solitaire is classified as *Raphus solitarius*, and the Rodrigues solitaire as *Pezophaps solitaria*.

**Dodoma** (pop. 45,703) is a city in central Tanzania. In 1973, Tanzanians voted to move the country's capital from the coastal city of Dar es Salaam to Dodoma. The move was scheduled for completion in the 1990's. Dodoma was selected as the new site of the capital primarily because of its central location. For location, see *Tanzania* (map).

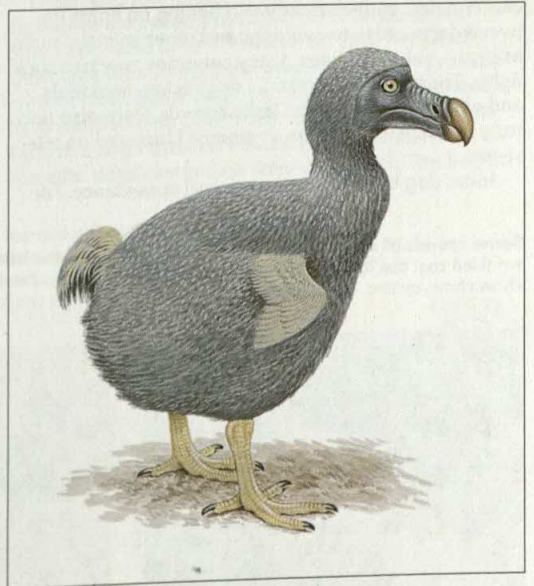
Dodoma's business district includes a number of modern commercial buildings. Most of the people live in small brick houses with tin roofs. Dodoma's industries include the manufacturing of bricks, and clay processing. A railway links Dodoma with Tanzania's east and west coasts, and an airport lies near the city.

Dodoma was a small village when the mainland of what is now Tanzania became a German colony in 1891. In the early 1900's, Great Britain gained control of the colony, and Dodoma became a marketing centre. Dodoma's population has more than doubled since the colony gained independence in 1961.

**Doe.** See *Deer*; *Goat*.

**Doenitz, Karl** (1891-1980), a German admiral, became commander in chief of the German fleet in January 1943, during World War II. Before this appointment, he directed development of the German submarine service. He invented the "wolf pack" technique of submarine warfare to penetrate convoy defences. With the collapse of Germany in 1945, Adolf Hitler chose Doenitz to succeed him as head of state. Doenitz concluded peace with the Allies.

Doenitz was tried for war crimes in Nuremberg, and he was sentenced to 10 years in prison. He was released in 1956. Doenitz was born in Berlin-Grünau.



The dodo had tiny wings that were so small it could not fly. Dodos lived on the island of Mauritius in the Indian Ocean. They have been extinct since about 1680.



# Dog

**Dog** is a popular pet throughout the world. At least 10,000 years ago, dogs became the first animals to be tamed. During that time, breeders have developed hundreds of dog breeds to perform various tasks, provide companionship, and please the human eye.

Most scientists believe that prehistoric human beings first valued dogs as watchdogs. Later, people realized that dogs could also be used for herding and hunting other animals. Over thousands of years, such breeds as collies, komondors, and pulis were developed to herd sheep, goats, and cattle. Hounds, pointers, retrievers, setters, spaniels, and terriers were bred for various kinds of hunting.

The intelligence, loyalty, and tracking ability that make dogs useful to herders and hunters serve people in other roles as well. For example, the police use dogs to track criminals and to sniff out illegal drugs and hidden explosives.

Dogs of all breeds provide company for human beings, and many breeds, including toy dogs, were developed specifically for this purpose. The companionship of a dog can contribute to a person's general well-being. Scientific studies have shown that petting a dog slows the heart rate and lowers the blood pressure of the person doing the petting.

Dogs help the disabled, guide the blind and serve as "ears" for the deaf. In addition, dogs lift the spirits of patients in hospitals and nursing homes.

Medical researchers have also used dogs in experiments to help develop new lifesaving drugs and surgical techniques. However, some people believe that it is cruel to use dogs or any other animals in laboratory experiments.

Dogs have also entertained people for centuries. In earlier times, audiences enjoyed betting on fights between dogs and between dogs and other animals, such as bears, bulls, and lions. Many countries now ban such fights. Today, such contests as dog racing, field trials, and obedience trials draw large crowds. Dogs also perform in circuses, on stage, in cinema films, and on television.

Some dog breeds have an unusual appearance. For

example, the Mexican hairless has no fur on its body except for a few tufts on the top of the head. The loose skin of the Chinese shar-pei folds into wrinkles. These wrinkles are so deep that they sometimes cover the dog's eyes. The chow chow has a blue-black tongue. The basenji is the only dog that cannot bark, though it can make a yodelling sound.

Dogs belong to the family Canidae, meat-eating animals that also includes wolves, coyotes, foxes, and jackals. Dogs resemble these animals in body structure and behaviour. The dingo of Australia and certain animals that live in other parts of the world are commonly referred to as *wild dogs*. See **Mammal** (picture: Young wild dogs).

## The body of a dog

Dogs vary greatly in size. The smallest breed is the Chihuahua. On average, Chihuahuas weigh only about 2 kilograms and stand about 13 centimetres high at the shoulders. The tallest breed is the Irish wolfhound, which may grow up to 86 centimetres in height. The St. Bernard ranks as the heaviest dog. It weighs as much as 90 kilograms.

The size, shape, and other characteristics of a dog's body vary widely from breed to breed. But in spite of their differences, all dogs share certain basic physical features. Except for limitations in size, all breeds can mate with one another and produce offspring.

**Coat.** Most dogs have two coats—an outer coat of long *guard hairs* and an undercoat of shorter, fluffy hair. The guard hairs protect the dog against rain and snow, and the undercoat keeps the dog warm. Most dogs shed the undercoat in late spring and grow it back in autumn. Dogs also have long, stiff whiskers about the muzzle. The whiskers are highly sensitive touch organs.

The texture, length, and colour of the coat differ greatly among the various breeds. The hair may be curly, as on the poodle, or straight, as on the German shepherd. The collie's coat feels rough, and the Kerry blue terrier's coat is soft. Such breeds as the Afghan hound and the Pekingese have a long, silky coat. The boxer and the whippet have an extremely short coat. The colour of the coat may vary even within a breed. For example, a Labrador retriever's coat may be black, yellow, or chocolate-brown.

**Some breeds of dogs have extremely unusual characteristics.** A shar-pei puppy, *left*, has a wrinkled coat that looks too large for its body. A black tongue is the distinguishing feature of the chow chow, *centre*. The puli, *right*, has a coat that becomes tangled into long, ropelike cords.





## Why dogs do the things they do

**Tail chasing** is a normal form of play for puppies. A puppy instinctively chases the tip of the tail, possibly because it resembles moving prey. Adult dogs are more likely to chase their tails because of inadequate exercise or inadequate attention from their owners. They also may have fleas or some other medical problem.



**Eating grass.** Most dogs seem to enjoy the flavour of grass. Dogs also eat grass when they have digestive disorders. The grass causes vomiting, which can help make the dog feel better.



**Panting** helps a dog stay cool. When saliva evaporates from the tongue and mouth, it has a cooling effect that helps reduce the dog's body heat. Unlike people, dogs cannot cool themselves by perspiring. They have sweat glands only in their feet, and the glands have little effect on body temperature.

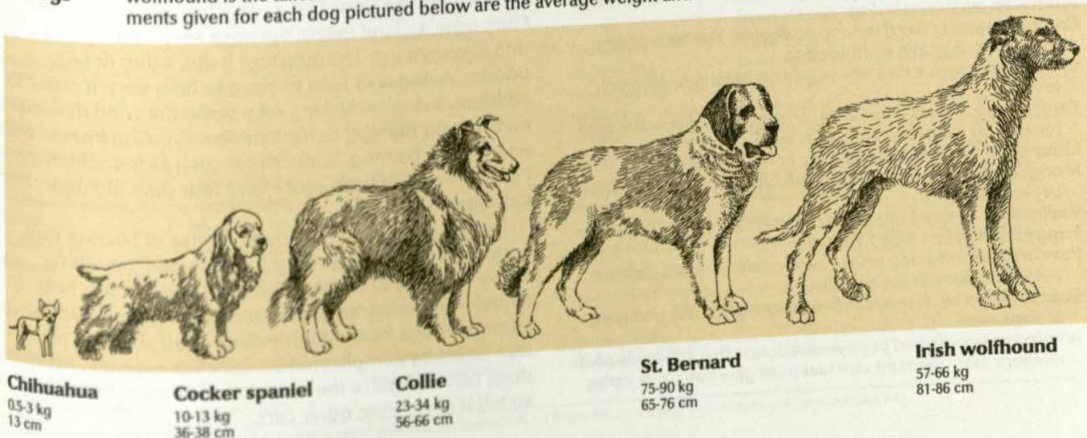
joint, especially of the forefeet, making it appear to have an extra joint.

Dogs have four toes on each foot plus an extra thumblike toe called a *dewclaw* on each front foot. Some dogs also have a dewclaw on each hind foot. Dewclaws do not reach the ground. Feet vary in shape considerably. Some dogs, such as the Newfoundland, have webbed feet. Others have feet like cats or hares. Each of a dog's toes has a blunt toenail, or claw. But unlike cats, dogs cannot pull their claws back. The bottoms

**Body structure** is determined mainly by a dog's skeleton. Dogs have an average of 320 bones. The exact number of bones varies, depending on the length of the dog's tail. Male dogs have one additional bone, located in the penis. It is called the *os penis*. Although all breeds have the same number of bones, the size and shape of the bones differ greatly from breed to breed. For example, the basset hound has very short, thick leg bones. In contrast, the greyhound has unusually long leg bones. The Chinese crested dog has unique elongation of the

## The sizes of dogs

The Chihuahua is the smallest breed of dog. The St. Bernard is the heaviest breed, and the Irish wolfhound is the tallest. Other breeds of dogs range in size between these extremes. The measurements given for each dog pictured below are the average weight and shoulder height for the breed.



**Chihuahua**  
0.5-3 kg  
13 cm

**Cocker spaniel**  
10-13 kg  
36-38 cm

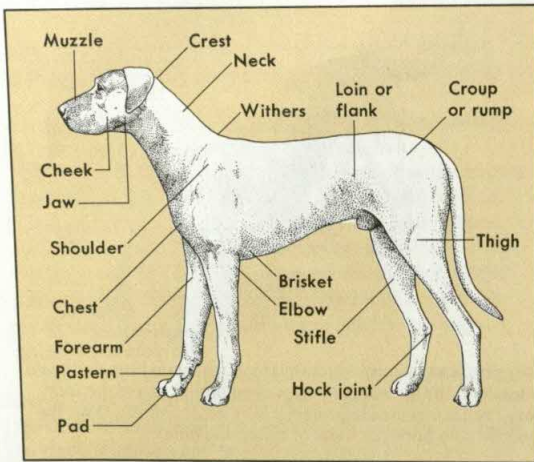
**Collie**  
23-34 kg  
56-66 cm

**St. Bernard**  
75-90 kg  
65-76 cm

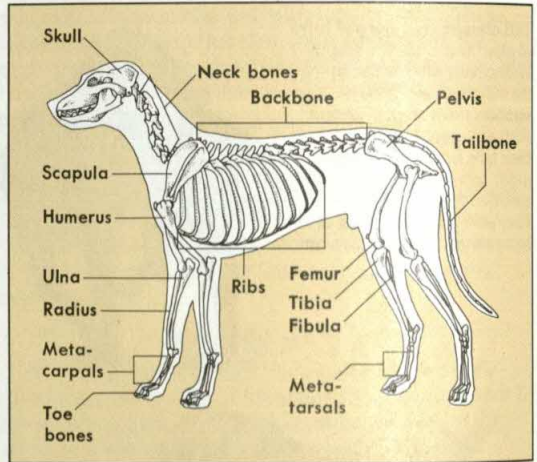
**Irish wolfhound**  
57-66 kg  
81-86 cm



## The body of a dog



## The skeleton of a dog



of a dog's paws have cushiony pads covered with tough skin.

The shape of the skull determines whether a dog has a long, slender face like that of a collie or a short, broad face like that of the bulldog, pug, and Pekingese. Long-faced dogs have eyes that are nearer the sides of their heads, giving them a wide field of vision. Dogs with broad skulls have eyes that look forward like those of human beings, letting them judge distances better.

Puppies have about 28 temporary teeth, which they begin to lose when they are about 5 months old. Adult dogs have about 42 teeth. Dogs with short faces have fewer teeth. A dog uses its 12 small front teeth, called *incisors*, to pick up food and groom itself. The dog tears meat with its 4 large, pointed *canine teeth*. It uses the 26 other teeth, its *premolars* and *molars*, to grind and crush food.

Many breeds of dogs have pointed, prick ears that stand straight up. Other breeds have *pendulous* ears, which hang down. Many people have the ears of certain pendulous-eared breeds *cropped* (cut) to make them stand up. Such breeds include Doberman pinschers and miniature schnauzers. Cropping is done at an age when

puppies are highly sensitive to pain. Australia, New Zealand and the Scandinavian countries have outlawed cropping as a cruel practice. On terriers and some other breeds, the tail is also *docked* (cut short). Docking is done a few days after birth and so is much less painful than ear cropping. However, docking a dog's tail does not benefit the dog at all and is only done to satisfy an owner's preference for a short tail.

**Body functions** of a dog differ only slightly from those of a human being. For example, a dog's heart beats 70 to 120 times per minute. The human heart, on average, beats 70 to 80 times per minute. A dog's normal body temperature is 38.6° C, only a little higher than a person's normal temperature of 37° C. But unlike human beings, dogs do not cool the body by sweating. Instead, a dog sticks out its tongue and pants. As the dog pants, evaporation of water from the mouth cools its body. Dogs do have sweat glands on the pads of the feet, but they play only a small role in reducing the body temperature.

**Senses.** A dog's most highly developed sense is its sense of smell. Dogs recognize objects chiefly by smell, much as people recognize them by sight. Dogs can detect some odours that are millions of times too faint for people to detect. By sniffing a group of objects, a dog can pick out the ones that a particular person touched. Fluid from a gland inside the nose keeps the tip of a dog's nose moist. The moisture helps a dog detect odours. A dog also licks its nose to help keep it moist. In addition, a dog's whiskers may sense the wind direction and so help the dog determine the direction from which an odour is coming. Some dogs, such as bloodhounds, can follow scent trails more than four days old under certain conditions.

Dogs also have a much better sense of hearing than people have. Dogs can hear high-pitched sounds far above the limit of human hearing. They can also hear sounds at much greater distances than people can. In addition, dogs have a highly developed ability to recognize different complicated sounds. For example, many dogs can recognize the sound of their owner's car and so tell it apart from other cars.

## Dog terms

**Bitch** is an adult female dog.

**Canine** is another word for *dog* or *doglike*. The term comes from *canis*, the Latin word for *dog*.

**Crossbred** means a dog whose parents belong to different breeds.

**Dog** is an adult male dog. However, the term is generally used for all dogs, regardless of age or sex.

**Litter** refers to a group of puppies born at one time.

**Mongrel** is a dog of such mixed ancestry that no one breed can be recognized.

**Pedigree** is a record of a purebred dog's ancestors.

**Puppy** is a dog less than 1 year old.

**Purebred** means a dog whose parents are of mixed descent, but who belong to the same breed.

**Studbook** is a book in which breeders register the pedigrees of dogs.

**Whelp** is an unweaned puppy—that is, one that still feeds on its mother's milk. The term also means to give birth to puppies.



## Breeds of purebred dogs\*

Breed	Place and probable date of origin	Breed	Place and probable date of origin	Breed	Place and probable date of origin
Alpenpinscher	European, 1700's	English foxhound	England, 1660's	Neopolitan mastiff	Italy, 1000 B.C.
Afghan hound	Unknown	English setter	England, 1500's	Newfoundland	Newfoundland, date unknown
Airedale terrier	England, 1800's	English springer spaniel	England, 1800's	Norfolk terrier	England, 1880
Alaskan malamute	Alaska, 1000 B.C.	English toy terrier (black & tan)	England, 1800's	Norwegian buhund	Norway, 400 A.D.
American foxhound	United States, 1600's	Eskimo dog	Siberia, ancient times	Norwegian elkhound	Norway, 5000-4000 B.C.
American Staffordshire terrier	United States, early 1900's	Field spaniel	England, 1800's	Norwegian lundehund	Norway
American water spaniel	United States, 1800's	Finnish spitz	Finland, about 1500 B.C.	Norwich terrier	England, 1880
Anatolian shepherd dog	Asia, ancient times	Flat coated retriever	England, 1800's	Nova Scotia duck	Canada
Australian cattle dog	Australia, 1800's	French bulldog	France, 1400's	Old English sheepdog	England, 1800's
Australian kelpie	Australia, 1800's	French spaniel	France, 1400's	Otterhound	England, 1300's
Australian silky terrier	Australia, about 1900	German longhaired pointer	Germany, 1860's	Papillon	Spain, 1500's
Australian terrier	Australia, 1885	German pinscher	Germany, ancient times	Pekingese	China, 700's
Basenji	Africa, 3400 B.C.	German shepherd dog	Germany, 1800's	Pembroke Welsh corgi	Wales, 1107
Basset Artesien Normand	France, 1800's	German shorthaired pointer	Germany, about 1900	Petit basset griffon vendéen	France, 1700's
Basset Fauve de Bretagne	France, 1800's	German spitz	Germany, ancient times	Pharaoh hound	Egypt, about 4000 B.C.
Basset hound	France, 1600's	German wirehaired pointer	Germany, 1870	Pointer	Spain, Portugal, eastern Europe and England about 1650
Beagle	England, Wales, 1600's	Giant schnauzer	Bavaria, 1600-1800	Polish lowland sheepdog	Poland, ancient times
Bearded collie	Scotland, early 1500's	Glen of Inml terrier	Ireland, 1800's	Pomeranian	Pomerania, Poland, 1800's
Beauceron	France 1800's	Golden retriever	Scotland, 1870	Poodle	Germany, 1500's
Bedlington terrier	England, 1800's	Gordon setter	Scotland, 1600's	Portuguese water dog	Portugal, 700's
Belgian Malinois	Belgium, 1800's	Grand bleu de Gascogne	France, 200 A.D.	Pudel pointer	Germany, 1880's
Belgian sheepdog	Belgium, 1800's	Great Dane	Germany, 1500's	Pug	China, 1700's
Belgian Tervuren	Belgium, about 1880	Great Pyrenees	France, 1800-1000 B.C.	Puli	Hungary, 1000's
Bernese mountain dog	Switzerland, 100 B.C.	Greyhound	Egypt, 4000-3500 B.C.	Pyrenean sheepdog	France, ancient times
Bichon Frise	Mediterranean, 200 B.C.	Hamiltonstovare	Germany, 1800's	Rhodesian ridgeback	Africa, 1700's
Black & tan coonhound	United States, 1700's	Harrier	France, 1000's	Rottweiler	Germany, about A.D. 50
Bloodhound	Middle East, 100 B.C.	Hovawart	Germany, 1200's	St Bernard	Switzerland, 1600's
Border collie	England, ancient times	Ibizan hound	Egypt, ancient times	Saluki	Middle East, about 5000 B.C.
Border terrier	Scottish-English border, 1700's	Irish red & white setter	Ireland, 1700's	Samoyed	Northern Siberia, 1000 B.C. or earlier
Borzoi	Russia, 1600's	Irish setter	Ireland, 1700's	Schipperke	Belgium, 1600's
Boston terrier	United States, 1870	Irish terrier	Ireland, 1700's	Scottish terrier	Scotland, 1800's
Bouvier des Flandres	Flanders, 1800's	Irish water spaniel	Ireland, 1800's	Sealyham terrier	Wales, 1800's
Boxer	Germany, 1800's	Irish wolfhound	Ireland, 400's	Shar pei	China, ancient times
Briard	France, 800's	Italian greyhound	Italy, 100 B.C.	Shetland sheepdog	Shetland Islands, 1600's
Brittany	France, 1800's	Italian spinone	Italy	Shiba inu	China, 1000 B.C.
Brussels griffon	Belgium, 1600's	Jack Russell terrier	England, 1800's	Shih tzu	China, ancient times
Bulldog	England, 1200's	Japanese akita	Japan, 1600's	Siberian husky	Siberia, about 1000 B.C.
Bullmastiff	England, 1800's	Japanese chin	China, ancient times	Skye terrier	Scotland, 1600's
Bull terrier	England, 1800's	Japanese spitz	Japan, ancient times	Sloughi	Egypt, 5000's B.C.
Cairn terrier	Scotland, 1700's	Keeshond	Holland, 1500's	Smooth fox terrier	England, mid-1800's
Canaan dog	Israel, ancient times	Kerry blue terrier	Ireland, 1800's	Soft-coated wheaten terrier	Ireland, 1900's
Cardigan Welsh corgi	Wales, about 1200 B.C.	King Charles spaniel	Japan or China, ancient times	Staffordshire bull terrier	England, 1800's
Cavalier King Charles spaniel	Wales, about 1200 B.C.	Komondor	Hungary, 900's	Standard schnauzer	Germany, 1400's
Chesapeake Bay retriever	England, 1400's	Kuvasz	Tibet, 1200's	Stumpy tail cattle dog	Australia, 1800's
Chihuahua	United States, 1800's	Labrador retriever	Newfoundland, 1800's	Sussex spaniel	England, 1800's
Chinese crested	Mexico, 1500's or earlier	Lakeland terrier	England, 1800's	Swedish vallhund	Sweden, ancient times
Chow chow	China, Africa, ancient times	Lancashire heeler	Germany, 1800's	Tibetan mastiff	Tibet, ancient times
Cocker spaniel	China, 150 B.C.	Large Munsterlander	Germany, 1846	Tibetan spaniel	Tibet, 200 B.C.
Collie	England, 1800's	Leonberger	Tibet, about 1100	Tibetan terrier	Tibet, about 50 B.C.
Curly-coated retriever	England, 1800's	Lhasa apso	Mediterranean, ancient times	Vizsla	Hungary, 1000's
Dachshund	Scotland, 1600's	Lowchen	Malta, 800 B.C. or earlier	Weimaraner	Germany, 1800's
Dachshund	England, 1800's	Maltese	England, 1800's	Welsh springer spaniel	Wales, 1700's
Dalmatian	Germany, 1700's	Manchester terrier	Italy, ancient times	Welsh terrier	Wales, 1700's
Dandie Dinmont terrier	Germany, 1700's	Maremma sheepdog	The Middle East, ancient times	West Highland white terrier	Scotland, 1600's
Deerhound	Dalmatia, Austria, 1700's	Mastiff	South America, ancient times	Whippet	England, 1800's
Doberman pinscher	England and Scotland, about 1700	Mexican hairless	Germany, 1700's	Wire fox terrier	England, late 1800's
English cocker spaniel	Scotland, 1500's	Miniature pinscher	Germany, 1800's	Wirehaired pointing griffon	The Netherlands and France, 1800's
	Germany, 1800's	Miniature schnauzer	Germany, 1800's	Yorkshire terrier	England, 1800's

\*Compiled from lists of the American Kennel Club, Australian Kennel Club, Canadian Kennel Club, FCI (Federation Cynologique Internationale), and The Kennel Club (UK).



**Sporting dogs**

Sporting dogs include breeds of pointers, setters, retrievers, and spaniels. Pointers and setters smell the air to locate birds and then point their body toward the game to guide the hunter. Retrievers pick up birds that have been shot and bring them back to the hunter. Retrievers can work on land, but they mainly retrieve birds from the water. Most spaniels help hunters by going into bushes or brush to *spring* (scare) birds into the air. Unlike other spaniels, the Irish water spaniel retrieves ducks and other birds from the water.

**Chesapeake Bay retriever****Golden retriever****Irish water spaniel****Brittany****English setter****Pointer****Labrador retriever**





Vizsla



Weimaraner



Cocker spaniel



American cocker spaniel



Springer spaniel



Gordon setter



Irish setter



German shorthaired pointer



## Hounds

There are more than 20 different breeds of hounds throughout the world. Hounds hunt either by smell or by sight. *Scent hounds*, such as beagles and foxhounds, run with their nose to the ground to follow an animal's scent. While they are trailing game, some other kinds of scent hounds *bay*—that is, they give out deep, long barks. Tall, slender *gaze hounds*, or *sight hounds*, were bred to hunt game by sight. Today, such gaze hounds as greyhounds and whippets are used in the sport of dog racing. Other breeds of gaze hounds include the Afghan hound and the saluki.



American foxhound



Irish wolfhound



Norwegian elkhound



Rhodesian ridgeback



Greyhound



Dachshund (wire-haired)



Borzoi





Beagle



Whippet



Basset hound



Saluki



Black and tan coonhound



Afghan hound



Bloodhound



Basenji



**Working dogs**

Working dogs serve people in various ways. For example, Doberman pinschers and mastiffs make excellent guard and police dogs. Alaskan malamutes, Samoyeds, and Siberian huskies pull sleds, and St. Bernards and Newfoundlands were bred for rescue work. It is likely that dogs were originally tamed 12,000 years ago to help human beings in their work.

**Newfoundland****Alaskan malamute****Great Dane****Samoyed****Boxer****Great Pyrenees****St. Bernard****Mastiff**



## Herding dogs

Historically, these hardy dogs were used to keep grazing cattle and sheep from straying, and to protect the livestock from wolves. Herding dogs also helped drive cattle and sheep to market. Many of these breeds are still popular as farm animals. This group includes some of the most popular pet breeds, such as the collie and the German shepherd dog.



Shetland sheepdog



Collie



Briard



Pembroke Welsh corgi



German shepherd dog



Old English sheepdog



Belgian Tervuren



## Terriers

There are over 20 recognized breeds of terrier. Terriers were originally bred to drive game out of holes in the ground. Their name comes from *terra*, the Latin word for *earth*. Most of the terrier breeds originated in England. The majority of terriers have a wiry coat and a bushy beard. Terriers make fearless watchdogs. They also help people by killing mice, rats, and other pests.



Airedale terrier



Irish terrier



Manchester terrier



Skye terrier



Welsh terrier



Bull terrier



Dandie Dinmont terrier





American Staffordshire terrier



Wheaten terrier



Bedlington terrier



Cairn terrier



Sealyham terrier



Scottish terrier



Smooth fox terrier



Kerry blue terrier



**Toy dogs**

Toy dogs consist of 17 small breeds kept as pets. In addition to these breeds, Manchester terriers also compete in the toy group at dog shows.

Toy breeds come from all parts of the world. For example, the Chihuahua was developed in Mexico, the Pekingese in China, and the papillon in Spain. The largest toy dog, according to European and Australian standards, is the cavalier King Charles spaniel. It weighs up to 9 kilograms.

**Yorkshire terrier****Maltese****Brussels griffon****Shih Tzu****Pug****Pekingese****Miniature pinscher****Pomeranian****Affenpinscher****Chihuahua**



## Nonsporting dogs

Nonsporting dogs are breeds kept chiefly as pets. Many of these breeds were originally bred for work or sport. Poodles, for example, once retrieved ducks for French hunters. Dalmatians were used originally to guard horse-drawn vehicles. But they were also used to herd cattle and hunt game. The Boston terrier originated in the United States.



Keeshond



Bulldog



Poodle



Schipperke



Boston terrier



French bulldog



Lhasa apso



Tibetan terrier



Dalmatian





**A mother nurses her puppies** until they are about 6 weeks old. Most litters consist of 4 to 6 pups, but litters of 15 or more have been reported. These dogs are Chesapeake Bay retrievers.

Dogs cannot see as well as people. Dogs detect movement well, which helps make them good hunters. But they see patterns and forms much more poorly than people do. A dog's colour vision is mainly limited to shades of grey and perhaps blue. Dogs therefore cannot tell certain colours apart. They see green, yellow, orange, and red as the same shade.

### Kinds of dogs

There are hundreds of breeds of *purebred* dogs throughout the world. A purebred is a dog whose *sire* (father) and *dam* (mother) belong to the same breed. A dog whose parents belong to different breeds is a *crossbred*. A *mongrel*, or *mutt*, is a dog with such mixed ancestry that no one breed can be recognized. Most dogs are crossbreds or mongrels.

Different kennel clubs throughout the world recognize different groups of dogs. Typical groups of dogs include Gundogs, Hounds, Non-sporting, Terriers, Toys, Utility, and Working. Neither do kennel clubs recognize the same number of breeds. The Australian, American, British and Canadian kennel clubs recognize about 160 breeds. While the worldwide federation of national dog clubs, the Federation Cynologique Internationale (FCI) recognizes over 300 breeds.

### The life of a dog

**Life history.** A *bitch* (female dog) carries her young for nine weeks before they are born. In most cases, a bitch gives birth to a litter of 4 to 6 puppies. Dogs are mammals, and so they feed their young on milk produced by the mother's body. A bitch nurses her pups until they are about 6 weeks old.

Puppies are born with their eyes closed and their ears sealed. Their eyes and ears open about 13 to 15 days after birth. Until that time, they depend entirely on their senses of touch and smell to detect things in their environment. These senses are well developed at or shortly after birth. During the third week of life, puppies begin

to walk and to respond to sights and sounds. Teeth begin to develop at 2 to 3 weeks, and they all have their milk teeth by 5 weeks.

Between 4 and 10 weeks of age, a puppy forms emotional attachments to its mother and its littermates. If the puppy is to become a good pet, it must have contact with people during this period. Such contact is the key to developing a close relationship with the dog that will last throughout its life. For this reason, the ideal time to adopt a puppy is when it is about 8 to 10 weeks old.

Dogs become fully grown at 8 months to 2 years of age, depending on the size of the breed. Large dogs develop more slowly than smaller breeds. It is difficult to compare the age of a dog to that of a human being. However, a 6-month-old puppy generally compares in development to a 10-year-old child, and a 2-year-old dog compares to a 24-year-old person. After a dog's second year, each year equals about four or five years of a person's life. On average, dogs live about 12 to 15 years. But most of the larger breeds have shorter life spans.

**Communication.** By the age of 4 weeks, a puppy can produce a dog's full range of vocal sounds—barks, growls, howls, whines, and yelps. Some of these sounds have different meanings in different situations. A whine, for example, may mean that the dog is in pain, that it wants something, or that it wishes to play. It may even whine in simple greeting. Barking has an especially wide variety of meanings, and dogs may bark in almost any situation.

Dogs also communicate through body language (body and tail postures and facial expressions). For example, a dog may tell another dog that it wants to play by stretching out its forelegs, bowing, panting, and perhaps pawing at the dog. In contrast, a dog may threaten another dog by standing stiffly, holding its tail up, showing its teeth, and staring. A dog uses a direct stare as a threat or challenge. But a dog will break eye contact as a sign of surrender to a more *dominant* (commanding) dog.

Another means of communication is through odours produced by certain glands or given off by urine. For example, the *anal glands*, which lie near the opening to the rectum, produce a distinct, foul odour when a dog is frightened. Male and female dogs urinate to mark their territory. Sometimes a male urinates on the spot where a companion female has urinated.

**Behaviour.** Much of a dog's behaviour resembles that of its wild relatives, such as coyotes and wolves. This behaviour is *instinctive*—that is, inherited rather than learned. For example, many dogs turn around several times before lying down, much as a wolf does in trampling down leaves or grass to make a bed.

A dog regards its owner's house and garden as its territory. For this reason, it may threaten or attack a strange person or dog that approaches the house or garden. A dog may also consider its owner's car an extension of its territory. While inside the car, such a dog will probably threaten any stranger who comes near.

A good understanding of dog behaviour and communication can help most people avoid dog bites. Never stare at a strange dog because it may consider your stare a threat and attack you. Also, never run past a strange dog. Your flight may trigger its chase response, and you may get bitten. But ignoring a dog may make



it suspicious of you. If you act friendly and speak to the dog, it will have less reason to challenge you.

As you approach a strange dog, observe how it reacts to you. Even a friendly dog will probably bark at you if you are on its territory. A dog that stays put or backs off when you approach regards you as a dominant intruder and will not attack. A dog that approaches with its tail wagging, even if it is barking, is probably friendly and will not bite. Be on guard, however, if a dog stiffens up, holds its tail high, snarls, and stares at you.

If a dog seems likely to attack, stand your ground. Stare back at it and shout "go home" in a powerful, angry voice. This bluff may scare the dog. Never lean back because any backward movement will suggest you are afraid. Keep your weight forward so you will be ready if the dog jumps at you. If it does jump, thrust your knee upward into the dog's chest. If you are carrying anything, use it as a shield. Always back away slowly as you leave a dog's territory. Never turn and run.

### Choosing a dog

Before buying a dog, you should consider what type of dog will best fit your needs, personality, and life style. You should decide whether you want a purebred or a mongrel, a small dog or a large one. You should also determine whether you want a long-haired dog, whose coat requires daily grooming, or a short-haired dog, whose coat needs less attention.

Both purebreds and mongrels make good pets. In general, mongrels live longer and have a better temper than purebreds. The main advantage of buying a purebred is that you know how the dog will look and how large it will be when fully grown. You also know whether a purebred has any special abilities, such as the ability to guard property or to retrieve game. Visits to dog shows and talks with owners of various breeds can help you decide which breed is the right one for you.

Your local animal rescue centre or animal shelter should have a variety of healthy mongrel pups from which to choose. The best place to buy a purebred is from an experienced breeder who takes obvious pride in his or her dogs. You can find such breeders at dog shows or through advertisements in local newspapers or national dog magazines. If possible, visit the kennels and see one or both of the parents of the pups. Make certain that the puppy you select is healthy. It should appear lively and playful and have bright, clear eyes, clean skin, and a shiny coat.

Avoid buying a dog from a pet shop or a dealer that has not been checked out. "Puppy farming" by unscrupulous people is one of the most serious canine welfare problems. Dogs are often bred in bad conditions with a poor diet, making their pups susceptible to disease. It is best therefore to make sure a pup comes from a line free of hereditary diseases (see *Heredity*).

### Caring for a dog

**Feeding.** A balanced diet for a dog supplies both calories for energy and nutrients for growth and replacement of body tissues. High-quality commercial dog food provides calories and nutrients in the proportions that your dog requires for good health. Adding extras yourself could upset this carefully formulated balance. Although dogs enjoy table scraps, no more than a quarter

of the diet should consist of such leftovers. Never feed your dog only meat because an all-meat diet is nutritionally unbalanced.

Get your puppy used to one or two brands of dog food. If you keep switching brands, your dog may get digestive disturbances. Even worse, the dog may become a finicky eater and this could harm its health.

Puppies should be fed small amounts four times a day until the age of 3 months. They should eat three times daily from 3 to 6 months of age and twice daily from 6 to 12 months of age. Most adult dogs require only one main meal a day. Whether you feed your dog in the morning or evening is up to you. But after you have chosen a feeding time, stick to it strictly.

Keep fresh, cool drinking water available at all times in a dish that your dog cannot tip over. Food and water bowls should be cleaned thoroughly every day. Many dogs enjoy a little fresh grass and should be allowed to eat it when outdoors. In addition, all dogs should have something safe to chew on to keep their gums and teeth healthy. A large dog biscuit, or a raw soupbone is ideal. Never give your dog any other kind of bone because it may splinter and cause serious internal injuries.

**Shelter.** A dog that lives indoors needs a clean sleeping box lined with blankets or shredded paper. Place the box in a quiet spot out of draughts and away from radiators or other heaters. A dog that lives outdoors should have a well-insulated kennel with a dry, warm floor. Cover the floor with wood shavings, sawdust, or blankets. To keep out dampness, raise the kennel off the ground on bricks or on a foundation of boards 10 to 15 centimetres wide. Shade should be provided during the summertime and a good windbreak during the winter. In extremely cold weather, a heat lamp may be needed.

**Grooming** cleans a dog's coat, removes ticks and fleas, and stimulates the skin. Brushing several times a week will keep a short-haired dog neat and clean. A long-haired dog should have its coat combed daily, and the dog may need clipping in hot weather to make it more comfortable and to prevent skin problems. A dog may be washed as often as necessary, but you must use warm water and a special shampoo that will not strip the oils from a dog's coat. Rinse and dry the dog thoroughly.



Careful grooming helps keep a dog's coat clean and free of loose hair. The Siberian husky shown above is receiving a final brushing before being exhibited in a dog show.



Get your puppy used to being groomed and handled right from the start. Check its teeth, ears, and toenails regularly.

**Exercise and play.** All dogs need regular exercise to keep them fit. Dogs that have the run of a large garden may get enough exercise on their own. Dogs kept in the house or in a small area outside should be taken for walks frequently, preferably twice a day. If you like to jog with your dog, do not overdo it with a young puppy or an old dog. Never take a dog of any age on a long run in hot weather.

Playing with your puppy helps it become adjusted to people. Play will give a pup more confidence and also teach it not to be too rough. A puppy should have toys that can be chewed, rolled, and tugged without splintering or breaking into dangerous pieces.

**Medical care.** Every new pup should be taken to a vet for a thorough checkup. It should also receive a series of injections against such common diseases as canine distemper, hepatitis, leptospirosis, and parvovirus. Adult dogs should also be given a checkup and any necessary booster shots by a vet once a year.

If your dog gets sick, do not try to treat it yourself. Take it to a vet. This will help protect your health as well as your pet's because the dog may have a disease that can be transmitted to people. The most dangerous of these diseases by far is rabies. In many countries, such as Australia, Ireland, Scandinavia, and the United Kingdom, rabies has been eradicated. Therefore, dogs coming to these countries from abroad must spend up to 6 months in *quarantine* (period of isolation).

All dog owners should learn to recognize signs of illness in dogs. A sick dog may tire easily, drink excessive amounts of water, or refuse to eat. Other signs of sickness include convulsions, fever, a dry cough, runny eyes and nose, or red eyes and a dry nose. Frequent and loose bowel movements for more than 24 hours or repeated vomiting may also indicate a medical problem. You should also seek veterinary care for your dog if it scratches certain areas excessively or yelps when touched in a particular spot.

Parasitic worms cause health problems for many dogs. All pups should be examined by a vet for these parasites and receive treatment if necessary.

Dogs also suffer from external parasites, chiefly fleas

and ticks. Dusting your dog and its sleeping quarters with flea powder once or twice a week should help keep the dog free of fleas. Flea collars should be used only on the advice of your vet.

**Social and moral responsibilities.** Dogs should be kept on a lead when they are in public areas. Each year many dogs are run over by traffic, and others cause accidents when drivers swerve to avoid them. Free-roaming dogs in rural areas kill livestock and wildlife. In addition, strays may be injured or killed in fights with other dogs.

Inconsiderate owners create unsanitary and unsightly conditions by allowing their dogs to have bowel movements on pavements and lawns and in parks. The authorities in some cities fine owners who do not clean up after their dogs.

Every year, animal shelters destroy millions of homeless and unwanted dogs. Because of this serious overpopulation problem, it is up to you to make sure that your dog does not father or give birth to unwanted puppies.

Adult male dogs can mate at any time. However, females will mate only when they are in a period of sexual excitement called *oestrus* or *heat*. In most females, oestrus occurs every six months and lasts about three weeks. If you own a female and do not want her to mate, keep her away from male dogs during oestrus. If she is accidentally allowed to mate, a vet may be able to prevent pregnancy by promptly injecting her with certain hormones.

Vets can permanently prevent a dog from reproducing by surgically removing some of its sex organs. This operation is called *spaying* when done on a female and *castration* when done on a male. Most vets recommend that a female should not be spayed until she has had at least one period of oestrus, and a male should not be castrated before the age of 6 months.

### Training a dog

Almost every dog can be trained to be an obedient, reliable, and well-adjusted companion. But you must establish and maintain a dominant relationship with your puppy to make such training possible. When you get your puppy, train it to come whenever you call. You should also teach it what "no" means right away. Repeat this command in a stern voice every time the dog does anything that displeases you. Never let your dog misbehave in any way. If you do, it may become uncontrollable.

Never strike a pup for being disobedient or aggressive. However, you may find it helpful to mimic some of the actions that a mother dog uses to discipline a pup. If your puppy plays too rough, for example, growl "bad dog," pin its snout to the ground with one hand, and shake the back of its neck with the other hand.

**Obedience training** should begin when your puppy is 8 weeks old. First, get the dog used to wearing a collar and lead, which will be helpful tools in training. You can then start to teach your pet such basic commands as "heel," "sit," "stay," and "down."

Give your dog a 10-minute lesson twice a day. Be patient but firm. The dog must understand that a command means instant obedience. Always make sure that your pet has mastered one command before you begin to teach it another. A dog learns by associating an action

### Famous dogs in history and legend

**Argos**, also spelled *Argus*, Ulysses' hunting dog, was the only creature to recognize the Greek hero when he returned home disguised as a beggar after 20 years of adventure.

**Bafo**, an Eskimo dog, led a dog team that carried diphtheria serum 1,050 kilometres through an Alaskan blizzard from Nenana to Nome in 1925.

**Barry**, a St. Bernard, rescued 40 people lost in the snows of Switzerland's St. Bernard Pass in about 1800.

**Caesar**, a terrier, was the pet of King Edward VII of the United Kingdom. He walked ahead of kings and princes in his master's funeral procession in 1910.

**Cerberus**, the three-headed dog of Greek mythology, guarded the gates to the underworld (see *Cerberus*).

**Igloo**, a fox terrier, was the special pet of Admiral Richard E. Byrd. He flew with Byrd on flights over the North and South poles.

**Laika** became the world's first space traveller. Soviet scientists sent the small dog aloft in an artificial earth satellite in 1957.



with your reaction to it. Therefore, you should always praise or correct the dog immediately. In addition, you must always react to a particular action in the same way so that your dog knows what to expect.

Many dog clubs and other organizations hold obedience-training classes for dogs. All kennel clubs sponsor obedience and agility competitions.

**Dog shows** are sponsored by kennel clubs in many countries. A dog must be registered with a kennel club to compete in such a contest. In Australia and the United Kingdom, there are seven categories of licensed shows: Championship, Exemption, Limited, Open, Matches, Primary, and Sanction shows.

The first recorded dog show was held at Newcastle-upon-Tyne, northeast England, in 1859. Probably the most prestigious international dog show is Crufts, staged by the Kennel Club of England in March.

The judges of a dog show rate each dog on how well it fits the standard for its breed. This standard includes such points as the shape and size of the dog's body and the colour and condition of its coat. The breed standard also describes an ideal posture and way of moving. The judges first pick the best dog of each breed. They then choose the best dog in each of the seven main groups of dogs. From these winners, the judges name the best dog in the show.

**Field trials** test the hunting ability of sporting dogs and hounds. Judges rate pointers and setters on their endurance, ability to scent game, and obedience to a handler's commands. In retriever field trials, judges score the dogs on how quickly they find the birds that a hunter has shot down and whether they return them without damage. Field trials for hounds test their skill in tracking game.

## History

Scientists believe that the dog gradually developed from a weasel-like animal called *Miacis*, which lived about 40 million years ago. They think that *Miacis* was the ancestor not only of dogs but also of such other mammals as bears and cats. By about 15 million years ago, a descendant of *Miacis* called *Tomarctus* had developed. *Tomarctus* probably looked much like a wolf and had many of the dog's social instincts. From *Tomarctus* came all the members of the dog family—that is, dogs, wolves, coyotes, jackals, and foxes.

The oldest site where fossilized human and dog remains occur dates from about 8000 B.C. At that time, human beings were nomadic hunters and plant gatherers. Many experts think that discarded refuse first attracted dogs to the camps of the hunters and gatherers. Dogs found it easier to feed on edible waste than to hunt for themselves, and so they gradually came to depend on people for food. People, in turn, began to tame and value dogs. Dogs kept the campsites clean by eating refuse, and they warned of the approach of strangers and dangerous animals by barking.

After taming dogs, people began to breed them for special physical features and for particular abilities, such as the ability to guard or to hunt. In this way, local varieties and eventually specific breeds of dogs were developed. Several distinct breeds already existed in the Middle East at least 4,000 years ago. One of these was the saluki—probably the oldest of all present-day breeds.

Many ancient civilizations developed their own special breeds of dogs. The ancient Greeks raised large hunting dogs called mastiffs. The Romans kept dogs as pets. They also used dogs to hunt and to herd sheep. The ancient Chinese bred watchdogs and hunting dogs. American Indians developed their own breeds centuries before Europeans took their dogs to the New World.

In 1570, an English physician named John Caius wrote a description of English dogs. He listed 16 breeds, including hounds, mastiffs, sheepdogs, and terriers.

Nearly all present-day breeds were well established in Europe by the 1800's. In 1884, the American Kennel Club began. Other kennel clubs followed, and now there are over 60 kennel clubs worldwide.

**Scientific classification.** Dogs belong to the dog family, Canidae. Domestic dogs of all breeds are classified as *Canis familiaris*.

**Related articles in *World Book* include:**

Other dogs		
Dog, Guide	Mexican hairless	Terrier
Eskimo dog	Shar-pei	Toy dog
Foxhound	Sheepdog	Wolfhound
Hound		

Dog family		
Coyote	Dingo	Wolf
	Fox	Jackal

Other related articles	
Breeding	Pedigree
Canine parvovirus	Pet
Distemper	Rabies
Greyhound racing	

## Outline

- I. The body of a dog
  - A. Coat
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  - D. Herding dogs
- III. The life of a dog
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- V. Caring for a dog
  - A. Feeding
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- C. Body functions
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- F. Toy dogs
- G. Nonsporting dogs
- C. Behaviour
- E. Medical care
- F. Social and moral responsibilities
- C. Field trials

## Questions

- What is a dog's most highly developed sense?  
 How long do dogs live on average?  
 Why does a dog pant?  
 What is the only dog that cannot bark?  
 Why should a person never stare at a strange dog?  
 What is the main advantage of buying a purebred puppy?  
 When did the earliest associations between dogs and people begin?  
 What are some signs of illness in dogs?  
 What are dewclaws?  
 What abilities do field trials test? Which breeds take part in these trials?



**Dog, Guide** is a dog specially trained to guide a blind person or to alert a hearing-impaired person to important sounds. Dogs that guide blind people are called *guide dogs* or *seeing eye dogs*, and those that assist hearing-impaired people are called *hearing dogs* or *hearing ear dogs*. Dogs chosen for either kind of training must show qualities of good disposition, intelligence, physical fitness, and responsibility. Breeds best suited for guide dog work include German shepherds, Labrador retrievers, and golden retrievers. Hearing dogs are usually mixed breeds selected from animal shelters.

Guide dog users have rights of equal access to public places in many countries. They may be accompanied by their guide dogs in places where ordinary dogs are not allowed. These places include shops, restaurants, and hotels, as well as all forms of public transport. A guide dog can be recognized by its special harness attached to a U-shaped handle. A hearing dog may be recognized by a bright orange or yellow collar and leash.

**Guide dogs.** For the first year of their lives, most future guide dogs live with families. They learn basic obedience and get used to such experiences as living with people and pets, travelling in cars and other transportation, and visiting public places. At the age of about a year, a guide dog begins an intensive course that lasts from three to five months. It becomes accustomed to the leather harness and the stiff handle it will wear when guiding its blind owner. The dog learns to watch traffic and to cross streets safely. It also learns to obey such commands as "forward," "left," "right," and "sit," and to disobey commands that might lead its owner into danger. For example, a guide dog will refuse to cross a street unless traffic has stopped.



A **guide dog** leads its blind owner. These dogs are trained to avoid obstacles and dangerous situations, such as busy traffic.

The most important part of the training course is a four-week programme in which the dog and its future owner learn to work together. But many blind people are unsuited by temperament to work with dogs. Only about a tenth of blind people generally find a guide dog useful.

The organized training of guide dogs began in Germany during World War I (1914-1918). Many other countries developed guide dog schools during the 1920's and 1930's. Most are organized and financed by charities.

**Hearing dogs** begin training between the ages of 8 months and 16 months. In addition to basic obedience, the dogs learn to alert their owners to such common sounds as alarm clocks, doorbells, and telephones, and to sounds that may warn of danger, such as crying babies and smoke alarms. Training is usually completed in three to four months. At the end of the course, the dog's trainer teaches the new owner how to care for the dog and keep it well trained.

**Dog on the tucker box** is a bronze statue of a dog sitting on a *tucker box* (food box) on the Hume Highway about 8 kilometres from Gundagai, in New South Wales, Australia. The townspeople erected the statue in honour of local pioneers. See also **Gundagai** (picture).

**Dog-proof fences** have been constructed in southern and eastern Australia to protect sheep from dingoes. A typical fence has wooden or iron posts. They are strung with four plain wires on which strong wire netting is attached to form an effective barrier against dingoes. The individual barriers are now connected to form a continuous dog-proof fence 8,500 kilometres long through the states of Queensland, New South Wales, and South Australia.



A **hearing dog** alerts its owner to common sounds. The dog in this picture is being trained to respond to a cooking timer.



**Dog racing.** See Greyhound racing.

**Dog show.** See Dog (Dog shows).

**Dog sledge.** See Sledge; Inuit (Transportation).

**Dog Star.** See Sirius.

**Dogbane** is the name of 11 closely related plants. They grow in the north temperate zone, mostly in the United States and Canada. All the dogbanes are poisonous green plants which contain a milky bitter juice. But they are not very dangerous because most grazing animals dislike the bitter juice and soon learn not to eat them.

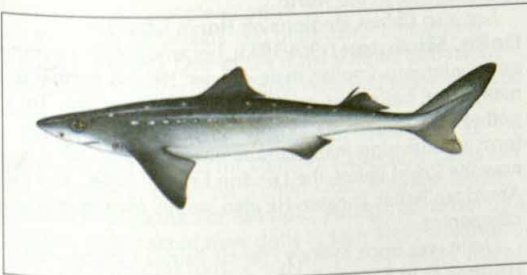
A common dogbane called the *spreading dogbane*, or *honeybloom*, has light-green leaves and clusters of pale pink flowers. This dogbane has a bitter root which doctors sometimes use to cause vomiting. Another dogbane called the *Canada hemp*, or *Indian hemp*, has greenish-white flowers that grow in clusters. The bark of this dogbane produces a long, strong white fibre that is used for the manufacture of nets.

**Scientific classification.** Dogbanes belong to the dogbane family, Apocynaceae. The spreading dogbane is *Apocynum androsaemifolium*. The Indian hemp is *A. cannabinum*.

**Doge** was the title of the rulers of Venice from 697 to 1797. *Doge* comes from the Latin word *dux*, meaning leader. Genoa also had doges.

The doges of Venice were elected for life from among the richest and most powerful families. They enjoyed almost absolute power in governmental, military, and church affairs until 1032. After that time, the people limited the doges' power by surrounding them with officials who could overrule them. In 1797, French troops led by Napoleon Bonaparte occupied Venice. Napoleon abolished the office of doge.

See also **Genoa; Venice** (picture).



The spiny dogfish is a member of the shark family.

**Dogfish** is a type of small shark that lives in the ocean. There are about nine species of dogfish. Most measure less than 1.5 metres long. Dogfish have no bones. Their entire skeleton is made up of cartilage. Most types of dogfish are brown with dark spots.



Spreading dogbane

Dogfish produce eggs in rectangular, horny cases with a long tendril at each corner that anchors the eggs to waterweeds. The empty cases, which are often washed ashore, are called *mermaid's purses*.

The best-known dogfish is the *spiny dogfish*. This fish has sharp spines in front of its *dorsal* (back) fins. Spiny dogfish can be found along the Atlantic and Pacific coasts of North America, and the Atlantic coast of Europe. In Europe, especially in England, spiny dogfish are an important food known as *rock salmon*. Dogfish skin can be dried and used to polish wood. Fishermen on the Pacific coast of North America catch dogfish to make oil from their livers.

One type of shark is sometimes called the *smooth dogfish*. However, the smooth dogfish does not belong to the dogfish family.

**Scientific classification.** Dogfish belong to the family Squalidae. The spiny dogfish is *Squalus acanthias*.

**Dogger Bank** is a large sandbank in the North Sea about 160 kilometres off the northeast coast of England. The water over the bank is between 15 and 37 metres deep. Shoals of cod and herring feed there. In 1915, during World War I, the Royal Navy fought an indecisive battle against the German fleet off Dogger Bank.

**Dogs, Isle of,** is a small island on the north side of the River Thames in the East End of London. It forms the southern part of the borough of Tower Hamlets and lies in the centre of London's former dockland. In 1982, an *enterprise zone* was set up on the Isle of Dogs, and many new industries moved into the former dockland areas. They included the Billingsgate fish market, the Daily Telegraph printing works, and a television production company.

**Dogtooth violet** is any of a group of about 30 plants of the lily family that grow in temperate regions of the Northern Hemisphere. The plants are named after their



The dogtooth violet is a dainty spring wild flower.

small, pointed white bulbs, which look like dogs' teeth. Dogtooth violets break through the ground in the early spring and receive plenty of daylight before trees grow leaves, and shade the ground. The smooth grey-green leaves are mottled with brown, and spring directly from the bulbs. The flowers have backward curved petals that may be yellow, white, purple, or pink. The flowers have a faint fragrance.

**Scientific classification.** Dogtooth violets belong to the lily family, Liliaceae. The common dogtooth violet of Eastern North America is *Erythronium americanum*. A common purple flowered species of Eurasia is *E. denscanis*.





The flowering dogwood is a small North American tree that is covered with large flowers in springtime. The flower has four large modified leaves called *bracts*.

**Dogwood** is the common name for a group of herbs, shrubs, and small trees in Europe and North America. About 40 kinds are known.

The best known is the *flowering*, or *American, dogwood*. It has four large whitish *bracts* (modified leaves) beneath its small, greenish-white flowers. The bright-red *drupes* (fruits) usually have two seeds. The leaves have parallel veins that curve upwards, and are quite rich in calcium. The polygonal pattern of the bark and the grey, urn-shaped flower buds make the dogwood an attractive winter tree. Flowering dogwood rarely grows more than 12 metres tall.

Several species and cultivated forms of dogwoods are grown as ornamental plants. These include the *European cornelian cherry*, with golden yellow flowers and red oval berries. The *North American bunchberry* is a good ground-cover plant. The plant only grows up to 12 centimetres tall, and the leaves provide dense cover. The *giant dogwood* of the Far East is the tallest species, over 6 metres, with blue-black berries.

**Scientific classification.** Dogwoods belong to the dogwood family, Cornaceae. Flowering dogwood is *Cornus florida*. European cornelian cherry is *C. mas*. North American bunchberry is *C. canadensis*. Giant dogwood is *C. controversa*.

**Doha**, also called Ad Dawhah (pop. 217,294), is the capital, largest city, and chief port of Qatar, a country on the

Persian Gulf. Doha lies on the east coast of this Arab nation. For location, see **Qatar** (map).

Doha was a minor fishing port until the 1950's, when Qatar's rapidly developing oil wealth caused the city to change greatly. Doha became the commercial centre of Qatar, and its population grew quickly. Many Arabs from nearby countries moved to Doha.

The city began a modernization programme in the 1950's. This programme included construction of an international airport and of a new harbour to serve ocean-going ships. Air-conditioned flats and government buildings, hospitals, hotels, and schools replaced many of Doha's mud-walled houses.

See also **Qatar** (picture).

**Doherty, Sean** (1944- ), an Irish politician, was the Republic of Ireland's Minister for Justice from March 1982 to December 1982. He held the post in the Fianna Fáil government of Charles Haughey.

Doherty was born at Cootehall, Boyle, in County Roscommon. He was elected to Dáil Éireann in 1977. From 1979 to 1981, he was a Minister of State in the Justice Department. Before entering politics, Doherty had a variety of occupations, including a period of service with the *Garda Síochána* (the Irish police force) that lasted from 1965 to 1973.

**Dolbear, Amos E.** (1837-1910), an American physicist and inventor, might be known today as the inventor of the telephone and radio, if he had only had better luck. In 1864, he made a "talking machine" much like the telephone Alexander Graham Bell patented in 1876. Dolbear insisted the idea was his. After a long, bitter court fight, Bell was declared the true inventor. Dolbear produced radio waves in 1882, but the discovery is usually credited to the German scientist Heinrich R. Hertz in 1888. Dolbear was born in Norwich, Connecticut, in the United States.

**Doldrums** is a belt of calms, light breezes, or sudden squalls near the equator, mainly over the oceans. Meteorologists call it the *intertropic convergence zone*. The name *doldrums* means *listlessness*. Sailors were the first to use this name for the region near the equator because their sailing ships often were *becalmed* (unable to sail) there.

In the doldrums, the air moves upward, causing sudden thunderstorms and gusty winds. The region is one of the rainiest in the world.

See also **Calms**, **Regions of; Horse latitudes**.

**Dolin, Sir Anton** (1904-1983), became the first internationally famous English male dancer. He was partner to many great ballerinas, particularly Alicia Markova. Together they helped start English ballet. Dolin helped form and develop many companies, including what is now the Royal Ballet, the London Festival Ballet, and the American Ballet Theater. He also led his own touring companies.

Dolin was born Sydney Francis Patrick Chippendall Healey-Kay in Sussex, England. He became the only English-born male dancer to star with the famous Diaghilev ballet company. Dolin enjoyed his greatest triumphs with Alicia Markova in his version of *Giselle* in the United States. As a *choreographer* (dance composer), Dolin composed his best-known ballet, *Le Pas de Quatre*, for Markova. He was knighted by Queen Elizabeth II in 1981.





The enchanting world of dolls is filled with lovable characters of every description. Some dolls represent babies, children, teenagers, or brides. Others include costume dolls and rag dolls.

## Doll

**Doll** is a child's toy made to look like a human being. Dolls vary in size from about 1 centimetre tall to life-size or larger. They may be made of almost any material, including cloth, plastic, and wood.

Children throughout the world enjoy playing with dolls. But dolls also appeal to adults. Many adults collect antique and costume dolls as a hobby and a way to learn about the people of other times and places. There are thousands of private and public doll collections around the world. One of the most famous doll-lovers was Queen Victoria of England, who had more than 100 dolls.

Dolls fulfil many needs of children. They serve as playmates and objects for children's affection. Dolls can also provide an outlet for a child's hurt feelings, anger, and other emotions. For example, youngsters upset by a scolding might scold their dolls in turn. How children play with dolls may thus reveal their inner needs, fears, and desires. For this reason, psychologists use dolls to help them identify and treat many problems of children. Playing with dolls also enables children to rehearse the roles they hope to perform as adults.

Dolls as we know them—that is, mainly as toys for children—probably did not exist before the 1700's. Most doll-like figures from earlier periods were not toys but magical or religious objects. Ancient peoples made

human figures as idols or *fetishes* (objects with magic power). Later, Christians made doll-like statues and images of saints.

The toy dolls that existed before the 1700's served chiefly as playthings for adults as well as for children. At that time, adults and children were more alike in their attitudes and interests than they are today, and childhood as we know it did not exist. Youngsters were regarded as little adults and expected to act like them. They shared the work of supporting the family with their parents. People of nearly all ages enjoyed the same simple toys, including dolls and jack-in-the-boxes. The dolls were shaped and dressed like adults. During the 1700's and especially the 1800's, adults came to regard childhood as a special time. The first dolls specifically for children were made in the 1700's, and the first baby dolls appeared about 1850.

The word *doll* came into use about 1750. It may have come from the Greek word *eidolon*, meaning *idol*, or from Dolly, a nickname for Dorothy. Before that time, English-speaking people called dolls *puppets* or *babies*, though most represented adults.

### Dolls around the world

Many manufactured dolls, including baby dolls and fashion dolls with large wardrobes, are the same throughout the world. But other dolls vary from country to country. These dolls include (1) costume dolls and (2) traditional dolls.



**Costume dolls** are dressed in the national costumes of various countries. For example, Scottish costume dolls wear kilts, and German boy dolls wear short leather trousers called *lederhosen*. However, many of the costumes worn by the dolls are no longer worn by the people of a country, except perhaps on public holidays and other special occasions.

Most costume dolls are not played with by the children of the country they represent. Instead, the dolls are made in factories especially for the souvenir market. Dolls in local costume were first produced in the late 1800's, when the tourist trade suddenly began to develop. At first, most countries imported dolls from France and Germany, which were then the leading doll-making nations, and dressed the dolls in local costume. In countries where most people had dark skin, the fair-skinned imported dolls were tinted brown. Over the years, however, many countries began to make their own costume dolls.

**Traditional dolls**, or *folk dolls*, may also be dressed in national costume. But unlike costume dolls, which are factory produced, folk dolls are made by local craftworkers using traditional handicraft skills. Most folk dolls are created from whatever materials are readily available in the area. For example, Eskimos make dolls from sealskin and whalebone, and people in tropical regions weave dolls from palm leaves. Other materials used for folk dolls include clay, cloth, corn cobs, deer-skin, straw, and wood.

Few peoples or countries outside Europe had folk dolls until they came into contact with European customs. But over the years, many peoples developed their own traditional dolls.

African craftworkers make dolls of such native materials as clay, feathers, and wood. Many dolls include discarded objects that the doll makers have found and reused. For example, some dolls are made from empty cartridge cases.

Russian craftworkers use pine cones and twigs to form traditional dolls known as *moss men*. These dolls wear cloaks of dried moss. Another traditional Russian doll is the famous *matreshka*, a set of four or more hollow wooden dolls that nest within one another.

Japan is one of the few countries in which children played with dolls before the country came into contact with Western customs. Traditional dolls include round figures with rotating heads and figures of chubby baby boys. Doll making is an art in Japan, and skilled masters teach it at schools throughout the country.

### Doll festivals and customs

The Japanese celebrate two yearly doll festivals, the Girls' Festival on March 3 and the Boys' Festival on May 5. During these celebrations, families display dolls that have been handed down for generations. Dolls for the Girls' Festival represent Japan's emperor and empress and members of their court. Dolls for the Boys' Festival include figures of heroes and warriors. Through the dolls, the children learn about their country's culture, history, and outstanding men and women.

Many peoples practise a type of magic with dolls made in the likeness of their enemies. The *voodoo dolls* of Haiti in the West Indies are a famous example. The magic involves sticking pins into the dolls or injuring

them in other ways in the hope that these actions will bring harm to the enemy.

In some societies, women carry figures called *fertility dolls*, which they hope will help them bear children or bear beautiful children. Ashanti women of Ghana tuck such a doll into their waistbands. Mfengu women of South Africa carry a fertility doll until their first child is born. The women then give the doll to the baby and get a new doll to carry until their next child is born.

### The history of dolls

**Ancient times.** The earliest doll-like figures known are wooden images found in Egyptian graves dating from about 2000 B.C. The figures are known as *paddle dolls* because they are carved from a flat piece of wood shaped like a paddle. They are painted with patterns to look like clothes and have strings of clay beads to represent hair or a headdress. Although the paddle dolls resemble dolls, they were religious figures, not playthings. The Egyptians buried these dolls with the dead to provide them with servants in the next world.

Doll-like figures have also been found in Greek and Roman tombs dating from the 300's and 200's B.C. They have jointed, movable arms and legs. Elegant ones are carved from bone or ivory, but most are made of wood or clay. Scholars do not know whether these figures were dolls or religious objects. But they do know that girls in ancient Greece played with dolls until shortly before marriage. They then left their dolls on the altar of Artemis, the goddess of childbirth, to show they had outgrown childish things.



**Russian stacking dolls**, painted to look like peasants, are hollow and fit inside one another. Woodcarvers make this type of doll, called a *matreshka*, in sets of 4, 6, 8, 10, 12, or more.



**The Middle Ages.** Scholars know very little about the toys of the Middle Ages, which lasted from the A.D. 400's to the 1500's. Almost no dolls from this period have survived. A few decorated manuscripts from medieval times show boys and girls playing with such simple toys as balls and kites but not with dolls.

The oldest surviving doll-like figures made of cloth date from the 500's and 600's and come from Akhmim, Egypt. They were found in graves of Copts, members of a Middle Eastern Christian group. The dolls' facial features and costumes are woven into the fabric that forms their bodies.

**The Renaissance** was a period of great cultural and intellectual activity that spread throughout most of Europe from about 1300 to the 1600's. During the Renaissance, the number of dolls increased. An interesting collection of toys from the mid-1400's was discovered in Nuremberg, in Germany. The toys are made of fine white clay that had been pressed into moulds and baked. The collection includes several dolls that represent fashionable European women of the time. The dolls may have been intended as christening gifts. Most of them have a circular hollow in their chest, which may have held a silver coin.

Dolls also appear in Renaissance paintings of children. These works include a portrait of Princess Marie of Saxony, painted about 1540, and a portrait of Lady Arbella Stuart of England, painted about 1600. The Germanic National Museum in Nuremberg has a wooden figure, probably a doll, that dates from about 1530.

Many doll-like figures from the Renaissance and later were religious images and not toys. For example, churches had realistic statues of saints with glass eyes, real hair, and actual clothing. Many homes and churches had displays at Christmas showing the scene at Jesus' birth. These displays, called *crèches*, included wax or wooden figures of baby Jesus, Joseph, Mary, shepherds,

and animals. The figures are known today as *crib dolls* or *crèche dolls*, but they were not playthings.

**The 1600's and 1700's** saw an increased demand for dolls and other toys and the gradual development of a toy industry. Germany began to develop as a toymaking centre during the 1600's. Many farm families spent the winter making dolls and other toys. In the spring, towns held fairs where people came from all over Europe to buy and sell toys. Two of the largest fairs were in Nuremberg and Sonneberg (near Erfurt) in Germany.

Nearly all surviving dolls of the 1600's and 1700's are wooden figures of women. Many of them have carefully carved faces full of personality. The earliest dolls have carved and painted eyes. Later ones have eyes made of glass. Some dolls of the 1700's were intended specially for children, though these dolls have surprisingly complicated clothes for children's toys. But girls married young in those days, and the dolls may have belonged to wives who were only 12 or 13 years old.

By the 1700's, dolls had become cruder. The dolls' heads and bodies were shaped on a lathe with little hand carving. Their limbs were little more than sticks, and their clothes were sewn and pasted right onto their bodies. Many of the dresses were a patchwork of silk and velvet, probably the scraps left from dressmaking or upholstery work.

Many dolls of the 1600's and 1700's were strictly adult amusements. In the mid-1700's, for example, French nobles entertained themselves with dolls called *pantins*. A *pantin* was a jumping jack—a paper or wooden figure which could be moved by pulling a string attached to its arms and legs.

In the mid-1700's, *pedlar dolls* became popular in England and remained popular for about 100 years. The dolls represented the pedlars who walked the streets selling their wares. The dolls carried baskets with dozens of miniature items for sale, including buttons,



A fertility doll is carried by Ashanti women of Ghana to bring them beautiful children.



Japanese festival dolls are displayed on shelves in homes during two yearly celebrations, the Girls' Festival on March 3 and the Boys' Festival on May 5. This pair of dolls, representing the emperor and empress of Japan, occupy the highest shelf during the Girls' Festival.





**An ancient Greek doll**, made about 400 B.C. of clay, is one of the oldest existing dolls.



**English wooden dolls** from the early 1700's have silk patchwork dresses made from sewing scraps.



**Papier-mâché dolls** became popular during the early 1800's. These dolls, with hairstyles moulded to their heads, were made in Germany in the 1820's and 1830's.

brushes, kettles, and spools of thread. People bought the dolls complete with wares or with an empty basket to fill. Both adults and children spent much time making little books, pincushions, and other items for their pedlars' baskets.

**The 1800's** brought dramatic changes in adults' attitudes toward children, which greatly affected the history of dolls. During the Middle Ages and Renaissance, children had been regarded as small adults. They were expected to behave as much like grown-ups as possible and had few dolls and other toys. Until the mid-1700's, even their clothes were copies of adult styles. But these attitudes were gradually changing. And during the 1800's, adults had come to consider play important to children's development and so provided them with more dolls and other toys.

Toymakers of the 1800's created many new kinds of dolls using a variety of materials. These dolls can be grouped as: (1) wooden dolls, (2) cloth dolls, (3) papier-mâché dolls, (4) wax dolls, and (5) china dolls.

**Wooden dolls** from Germany were the most common commercial dolls in Europe and the United States during the 1800's. The dolls had jointed arms and legs. English-speaking people called them *Dutch dolls*. Collectors today call them *pegwooden dolls* because wooden pegs hold the dolls' joints together.

**Cloth dolls** of the 1800's included soft rag dolls and dolls of stiffened fabric. Stiffened fabric dolls were made by a woman who was probably the first U.S. manufacturer of dolls—Izannah Walker. She invented a doll-making process in which layers of glued cloth were pressed between the two halves of a mould. Walker began making dolls in the 1840's and patented her process in 1873.

**Papier-mâché dolls.** Papier-mâché is made by mixing paper pulp with glue or other stiffeners. The mixture is easily moulded while wet and is hard and strong when dry. German factories began to mass-produce

papier-mâché doll heads in the early 1800's. Many of these heads were bought by people who attached homemade bodies to them. By the 1820's, factories also made complete dolls with papier-mâché heads, wooden arms and legs, and bodies of a soft leather called *kid*.

French toymakers produced a different type of papier-mâché doll during the early 1800's. The French dolls were cheap and flimsy, made for street pedlars to sell to holiday crowds. Some were dressed as fine ladies, and others as clowns or military officers. Only a few can still be found, and they are battered and torn.

**Wax dolls.** German toymakers began to make waxed doll heads during the early 1800's. The heads were made of papier-mâché and then dipped in wax to give them a richer finish. The dolls had bright glass eyes. The eyes of some dolls could be opened and closed by pulling a wire. The early dolls had arms and legs of pink or blue kid. Later ones came with wooden or plaster limbs. Some dolls had fancy hairdos of human hair or *mohair* (hair from the Angora goat). Others had hairdos and bonnets moulded in papier-mâché and waxed like the rest of their heads.

For centuries, waxworkers had made religious figures and other objects of *poured wax*. Such objects were made by pouring liquid wax into a mould and allowing the wax to harden. In the mid-1800's, United Kingdom toymakers began to use the technique to make costly dolls. Many dolls had real hair stuck into their heads strand by strand with hot needles. Eyebrows and eyelashes were added in the same way. The doll makers worked so skilfully that a doll's hair seemed to be growing from its head. The most famous wax-doll makers were two London families, the Montanaris and the Pietrottis. About 1850, Augusta Montanari used poured wax to create some of the first baby dolls. Before that time, most dolls represented adults.

**China dolls.** In the 1840's, china factories in Germany began to make doll heads both of ordinary china and of



fine china called *porcelain*. Most heads were of women with pretty faces, pale skin, and dark hair. Matching china arms and legs were also sold so that people could attach the head and limbs to a homemade body. Factories also produced complete dolls, with china heads and limbs and cloth or kid bodies.

During the 1870's, unglazed pottery called *bisque* or *biscuit* became fashionable for doll heads. Most bisque dolls had elaborate braids, curls, and ringlets decorated with combs, flowers, jewels, or ribbons. Unlike the dark-haired china dolls, most bisque dolls were blond. People called the dolls *fancy bisques* or *fancies*. During the 1890's, a much cheaper doll was made from coarser bisque. Collectors refer to these dolls as *bonnet dolls* because many have hats moulded onto their heads.

During the 1880's, French doll makers began to make dolls with the form and facial features of little girls. These dolls were called *bébés*, a French word meaning *babies*. Most *bébés* were named after their manufacturer. For example, *Bébé Bru* was made by a firm founded by Leon Casimir Bru. *Bébé Jumeau* was produced by a company founded by Pierre François Jumeau. Many *bébés* had a new kind of body. It consisted of a hollow trunk and ball-jointed limbs strung together with elastic. This construction allowed a doll to hold more natural, childlike poses. Most *bébés* had trunks of fancy clothes and accessories.

**Rivalry in the doll industry.** French manufacturers dominated the doll industry during the 1860's and 1870's. But by the 1880's, German firms again offered strong competition. The leading German companies included Armand Marseille, Kestner, and Kämmer & Reinhardt. Intense rivalry developed between French and German doll makers. If one firm introduced a new feature, an-

other would try to top it. Dolls had fur eyebrows, porcelain teeth, and movable rubber tongues. Many of them also had "sleeping eyes." A lead weight was attached to the eyes, causing them to close when the dolls were laid flat. Some dolls could walk. Others could even dance, moving to the tune of music boxes inside their bodies. *Mama dolls* had a built-in device that made them say "Mama." A German inventor, Johann Mäzel, had patented the device in 1824, but few manufacturers used it until the 1890's. The fierce competition between French and German firms lasted until World War I (1914-1918) ended doll making for several years.

**The early 1900's** produced a great variety of new dolls. Doll makers used many kinds of materials, but the most popular kind was *composition*. It consisted of a mixture of ingredients, chiefly resin, sawdust, starch, and water. The mixture became almost unbreakable after it had been moulded and baked.

In 1911, Albert Schoenhut, a German-born toymaker who lived in the U.S.A., patented the All-Wood Perfection Art Doll. The doll's joints had steel springs and swivels that enabled it to hold lifelike poses. Most Schoenhut dolls were children or infants with realistic faces. About the same time, an American illustrator named Rose O'Neill designed the comical *kewpie doll*, which she modelled on her baby brother. It had a tuft of hair at the top of the head. Millions of kewpie dolls were made in bisque, celluloid, and other materials.

About 1910, Käthe Kruse, a German actress and doll maker, began to produce dolls moulded from stiffened cloth. They looked like little children with slightly sad expressions. In the 1920's, an Italian designer named Elena Scavini made similar dolls from felt, which were sold under the trade name Lenci.



Wax dolls of the 1800's were made in two ways. The German doll, left, was made of a substance called *composition* and dipped in wax. The British doll, right, was made of poured wax.



The comical *kewpie doll* was designed about 1910 by Rose O'Neill, an American illustrator. The kewpie in the centre has a sticker on its stomach that says "Kewpie, Germany."



Many kinds of baby dolls besides kewpie dolls appeared in the early 1900's. One of the most successful was the Bye-Lo Baby, created in 1922 by an American sculptor named Grace Storey Putnam. Putnam used a newborn infant as a model, copying its half-closed eyes and fat neck. The doll was made of bisque, celluloid, rubber, or wax. It became one of the most popular dolls ever produced. Toymakers copied it so many times that it was known as the "million-dollar baby."

The rise of the cinema during the 1920's and 1930's led to a new type of doll, the *character doll*. Character dolls represented famous people or popular fictional characters. Successful character dolls of the mid-1930's included the cartoon figure Mickey Mouse and the child film star Shirley Temple.

Plastic dolls appeared in the late 1940's, and plastic quickly became the most popular doll material.



Dolls with manufactured heads on homemade bodies were common in the 1800's. The china heads on these dolls were made in German factories in the mid-1800's.

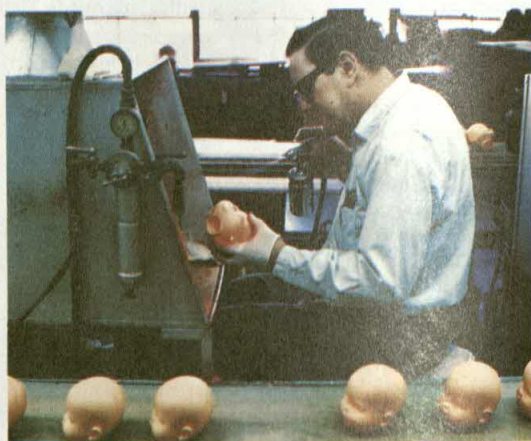
**Since the 1950's.** The most successful dolls of the 1950's were the teenage fashion dolls. The first one was Lilli, a West German doll produced in 1958. The American Barbie doll appeared in 1959. Like French lady dolls of 100 years earlier, these dolls have huge wardrobes. In the early 1960's, a soldier doll named G.I. Joe became the first doll designed specifically for boys to achieve worldwide popularity. Like Barbie, he has many clothes and accessories. In the 1980's, Cabbage Patch dolls became very popular dolls among young girls. Each of these dolls has its own name and even a birth certificate.

Beginning in the 1950's, doll manufacturers used many technical devices to achieve a high degree of realism. They created dolls that changed expression, dolls with hair that appeared to grow, and dolls that played catch. Many dolls were powered by batteries.

The 1970's brought renewed interest in the uncomplicated dolls of the past. As a result, manufacturers began to produce rag dolls and other simple, homemade-looking dolls that encouraged make-believe.

## How dolls are made

Doll manufacturers make most dolls from plastic. Separate moulds are made for the body, head, arms, and legs. Workers then add facial features and hair and assemble the parts.



Workers spray-paint the dolls' facial features.



A device like a sewing machine adds hair to the heads.



Assembly-line workers put the dolls together.



## The doll industry today

The creation of a modern doll begins in a doll manufacturer's design department, where artists sketch ideas for new dolls. After company officials select a design, the design department builds a full-sized clay or wax model of the doll. Mould makers then form metal moulds from the model. In most cases, they make separate moulds for the body, head, arms, and legs.

Most doll parts are moulded from vinyl or other plastics. The chief moulding processes are blow moulding and rotational moulding. In *blow moulding*, a machine squeezes hot, softened plastic into a mould. A blast of compressed air forces the plastic outward against the mould's cool walls, where it hardens. In *rotational moulding*, a worker squirts powdered plastic resin into a mould. The mould is put in an oven and rotated so the plastic melts and covers the inside walls of the moulds. The plastic hardens as it bakes.

After either moulding process, the moulds are opened and the doll parts removed. Skilled workers add facial features and hair to the heads. Finally, assembly-line workers attach the heads and limbs to the bodies, dress the dolls, and pack them. The dresses may be made in the same factory or purchased from specialists. The clothes have to be redesigned nearly every year to keep them up to date with fashion trends.

Today, China, Hong Kong, South Korea, and Taiwan are the leading producers of dolls. France, Germany and the United States are also major doll producers.

## Doll collecting

Doll collecting is a popular hobby. Collectors enjoy acquiring beautiful, rare, and unusual dolls. Depending on the kinds of dolls they collect, they may learn about the history, culture, and customs of other countries.

Antique dolls, particularly those more than 50 years old, are rare and expensive to buy. Collectors buy and sell such dolls at auctions, in antique shops, and through personal advertisements.

People who plan to collect dolls should study the subject of dolls before they buy any. They should read about dolls, about the historical periods when dolls were produced, and about the history of fashions and textiles. Beginners should also talk to experienced collectors. Above all, they should look at as many dolls as possible in museums and private collections.

Collectors should try to buy antique dolls in the original clothing. Some sellers re-dress dolls to make them look prettier, but this practice may decrease a doll's value and destroy clues to its history.

The rules of good collecting apply as much to cheap dolls as to antique dolls. Collect and keep only dolls that are complete and perfect. Save all labels and tags on the dolls and the boxes they came in. Store the dolls carefully to protect them from damage and dirt. When you display them, be sure they are not exposed to strong light, dust, or fumes.

## Dolls in museums

Many museums throughout the world have doll collections. Pedlar dolls and other old dolls may be seen in London's Bethnal Green Museum, a branch of the Victoria and Albert Museum. The Musée Carnavalet in Paris

has rare dolls and other toys. Two fine collections are in the Germanic National Museum in Nuremberg and the German Toy Museum in Sonneberg. Both cities are historic toymaking centres, and the museums have many dolls put away brand-new centuries ago.

**Related articles** in *World Book* include:

Dolls' house  
Fetish  
Play  
Puppet  
Toy

## Outline

- I. Dolls around the world
  - A. Costume dolls
  - B. Traditional dolls
- II. Doll festivals and customs
- III. The history of dolls
- IV. The doll industry today
- V. Doll collecting
- VI. Dolls in museums

## Questions

What is a character doll?  
What are some rules for beginning doll collectors?  
What was the first doll specifically for boys to achieve worldwide popularity?  
What were the popular dolls of the 1950's?  
Why did manufacturers begin to produce simple, homemade-looking dolls in the 1970's?  
What nations lead the world in doll production?  
What did people call dolls before 1750?  
What are some needs of children that dolls fulfil?

**Dollar** is the unit of money in many countries. The word *dollar* comes from *Joachimsthaler*—the name of a coin first made about 1516 in a silver-mining district of Bohemia (now in the Czech Republic). Within a few years, the coins had spread to all parts of Europe. People shortened *Joachimsthaler* to *thaler*. In English this became *dollar*, a name that was later applied to many silver coins. The name *dollar* was also used in England for a Spanish silver coin called a *peso*.

Dollars were used in the Spanish colonies in the Americas from the 1500's. They were the most important currency in the world for the next 300 years. They spread throughout Europe, the Americas, the West Indies, and along the coasts of Africa and Australia.

In the United States, the dollar became the official unit of currency in 1792. The first U.S. silver dollars appeared in 1794. Canada adopted the dollar in 1858. Hong Kong has used the dollar since the 1860's. The dollar became the official unit of currency in Australia in 1966, and of New Zealand in 1967. Many former United Kingdom possessions in the Caribbean adopted the dollar in the late 1960's and early 1970's.

See also **Money**.

**Dollarfish.** See **Butterfish**.

**Dolls' house** is a miniature house filled with tiny furniture and other home furnishings. Children like to play with dolls' houses, and many adults enjoy building and furnishing them as a hobby. Old dolls' houses show how people lived in the past.

The first dolls' houses were made in the 1600's for wealthy adults. Many stood about 2 metres tall or taller. They were furnished with fine furniture, pictures, china, and silver. Many Dutch merchants had *cabinet dolls' houses*, which were wooden cabinets with tiny rooms instead of drawers or shelves. Famous cabinet dolls'





**Queen Mary's dolls' house**, on display at Windsor Castle in the United Kingdom, is a highly detailed work of art.

houses include the Utrecht Dolls' house, made in 1670, and a dolls' house built in the early 1700's for a Dutch woman named Petronella Brandt.

Similar dolls' houses became popular in England during the 1700's. Unlike the Dutch dolls' houses, the English ones looked like real homes from the outside. Queen Mary's dolls' house in Windsor Castle is remarkably realistic inside and outside. It was designed by the architect Sir Edwin Lutyens for the 1923 Wembley Exhibition in London. After the event, the dolls' house was presented to Queen Mary for display in Windsor Castle.

Children's dolls' houses appeared in the 1800's. They were smaller than adult dolls' houses. Many had only one room and stood about 30 centimetres high.

**Dolmen.** See Megalithic monuments.

**Dolmetsch** is the name of a British musical family who have led the way in making and playing old kinds of instruments.

**Arnold Dolmetsch** (1858-1940) began renovating and reproducing old instruments in the late 1880's. With these instruments, he gave authentic performances of early music. He published a book on the interpretation of music of the 1600's and 1700's and founded a centre for the study of such music at Haslemere, Surrey, in southern England.

**Carl Dolmetsch** (1914- ) was Arnold Dolmetsch's son. He and other members of the family carried on his father's work. They founded a festival at Haslemere, with Carl as the director.

Father and son were born in France. Arnold was born at Le Mans and Carl at Fontenay-sous-Bois.

**Dolomite** is a mineral that serves as the chief source of magnesium obtained from the earth's crust. It is moderately hard and brittle and consists of calcium carbonate and magnesium carbonate. Dolomite's chemical formula is  $\text{CaMg}(\text{CO}_3)_2$ . Pure dolomite ranges in colour from white to yellow. Impurities, such as manganese or iron, may make dolomite pink, brown, or some other

colour. Dolomite and *calcite*, which consists only of calcium carbonate, often look alike. Chemical tests may be used to tell the two minerals apart.

The term *dolomite* also refers to rock composed principally of dolomite. Some dolomite rock may have formed from hardened deposits of mud and mineral matter on the ocean floor. Other forms of dolomite rock probably formed from the skeletal remains of sea life. Much dolomite rock contains fragments of fossils. Many mountain ranges in Europe and other parts of the world have great masses of dolomite rock.

Iron and steel manufacturers use dolomite in the smelting process. Finely ground dolomite is used as a filler in paint, putty, and rubber. Marble composed of dolomite crystals is famous for its unusual colours and is used as a building material.

See also **Marble**.

**Dolphin** is the name of a group of sea animals closely related to whales and porpoises. Like whales and porpoises, dolphins are mammals, not fish. Mammals, unlike fish, feed their young with milk that is produced in the mother's body. Also unlike fish, dolphins have lungs and are *warm-blooded*—that is, their body temperature always stays about the same, regardless of the temperature of their surroundings. Many scientists believe that dolphins are among the most intelligent animals, along with chimpanzees and dogs.

Dolphins, whales, and porpoises are members of a group of mammals called *cetaceans*. Dolphins and porpoises are very similar in appearance. Their chief differences occur in the snout and teeth. Dolphins have a



**A trained dolphin**, above, leaps high out of the water to snatch an object from a trainer's hand. Many dolphins are trained to perform in shows at aquariums and zoos.



beaklike snout and cone-shaped teeth. Porpoises have a rounded snout and flat or spade-shaped teeth. Whales are much larger than most dolphins and porpoises.

Scientists apply the term *dolphin* to two families of cetaceans, *marine dolphins* and *river dolphins*. There are 32 species of marine dolphins. They are found in nearly all oceans, and most of them live only in salt water. Many species of marine dolphins remain near land for most of their lives, but some live in the open sea. River dolphins live in fresh or slightly salty water. This article focuses on marine dolphins. For information about river dolphins, see *River dolphin*.

### Types of dolphins

The various species of dolphins range from 1.4 to 9 metres long and weigh from 45 kilograms to 9 metric tons. The most familiar types are the *bottle-nosed dolphin* and the *common dolphin*.

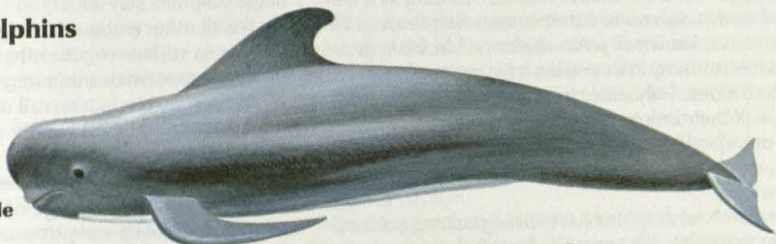
**The bottle-nosed dolphin** is the best-known species. Its short beak gives this dolphin an expression that

looks like a smile. Most performing dolphins in aquariums and zoos are bottle-nosed dolphins. Members of this species measure up to 4 metres long and can weigh as much as 272 kilograms. They are grey, but their backs are darker than their undersides. Bottle-nosed dolphins show apparent great friendliness toward people, and they often swim alongside ships. Bottle-nosed dolphins also adapt well to life in captivity.

Bottle-nosed dolphins live in temperate to tropical waters. Most of them stay within 160 kilometres of land. Many live in bays and protected inlets, where the water is relatively shallow. Bottle-nosed dolphins range as far north as Japan and Norway and as far south as Argentina, New Zealand, and South Africa.

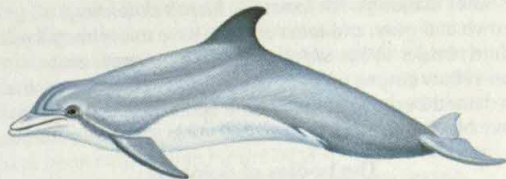
**The common dolphin** has several distinct features. For example, a dark band around the eyes extends to the end of the beak. Common dolphins also have black backs, white undersides, and grey and yellowish-brown stripes on their sides. These dolphins grow from 1.8 to 2.4 metres long and weigh up to 75 kilograms.

### Some kinds of dolphins



**Long-finned pilot whale**

*Globicephala melana*  
Lives in the Atlantic Ocean  
Length: up to 6 metres



**Bottle-nosed dolphin**

*Tursiops truncatus*  
Lives in temperate to tropical waters  
Length: up to 4 metres



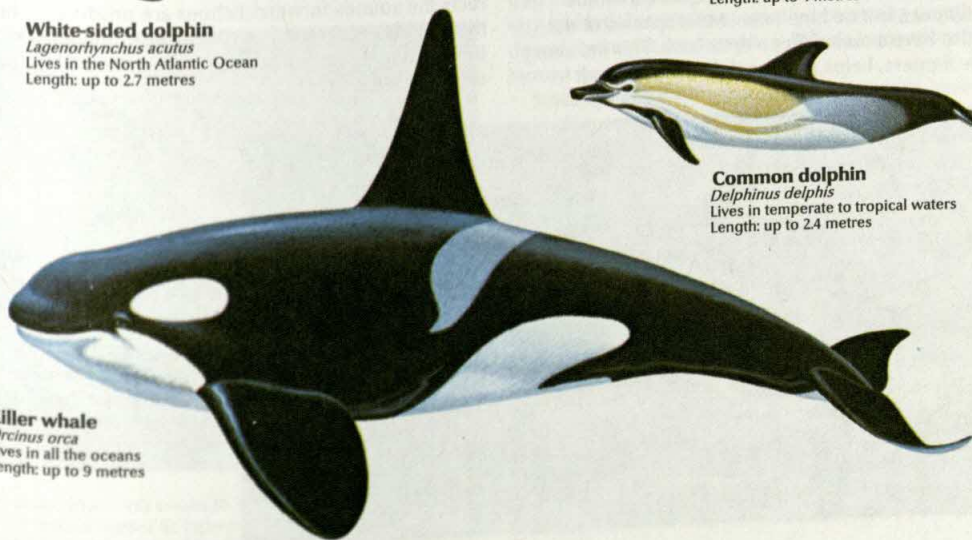
**White-sided dolphin**

*Lagenorhynchus acutus*  
Lives in the North Atlantic Ocean  
Length: up to 2.7 metres



**Common dolphin**

*Delphinus delphis*  
Lives in temperate to tropical waters  
Length: up to 2.4 metres



**Killer whale**

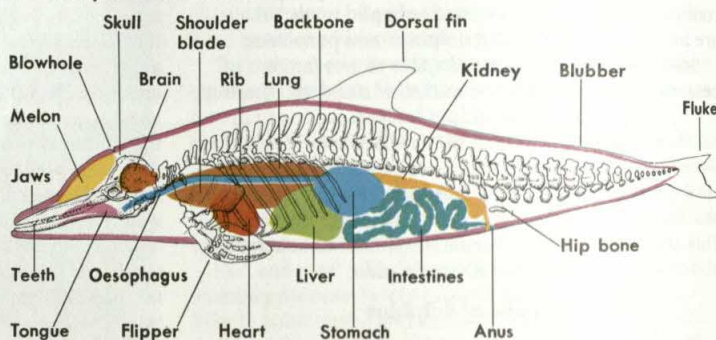
*Orcinus orca*  
Lives in all the oceans  
Length: up to 9 metres





Many sharp teeth line the dolphin's jaws. A fatty organ called the *melon* causes a bulge on top of the animal's head.

### The body of a common dolphin



Common dolphins live in temperate to tropical waters. They often swim in large schools and are frequently seen in the open ocean. Common dolphins sometimes follow ships for many kilometres and may leap out of the water and turn somersaults.

**Other species** include *killer whales*, which are the largest dolphins. Killer whales measure as long as 9 metres and may weigh up to 9 metric tons. Members of another species, known as *pilot whales* or *blackfish*, grow 4.6 to 6 metres long. Pilot whales have grey to black backs and sides. They differ from other large dolphins because of their bulging foreheads. Among the most numerous species of dolphins are *spinner dolphins*, which sometimes spin on their sides when they leap out of the water.

Many kinds of dolphins have distinguishing colours or other markings. For example, *Risso's dolphins* are brown and grey, and most of them have many irregular white streaks. *White-sided dolphins* have grey, white, and yellow stripes on their sides. *Spotted dolphins* are so named because of their white spots. *Striped dolphins* have black stripes on their sides.

### The bodies of dolphins

All dolphins have torpedo-shaped bodies, which enable the animals to move through the water quickly and easily. They have a pair of paddle-shaped forelimbs called *flippers*, but no hindlimbs. Most species of dolphins also have a *dorsal fin* on their back. This fin, along with the flippers, helps balance the animal when it

swims. Powerful tail fins, called *flukes*, propel dolphins through the water.

The skin of dolphins is smooth and rubbery. A layer of fat, called *blubber*, lies beneath the skin. The blubber keeps dolphins warm and acts as a storage place for food. It is lighter than water, and so it probably also helps dolphins stay afloat.

Like all other mammals, dolphins have lungs. The animals must surface regularly to breathe air and usually do so once or twice a minute. A dolphin breathes through a *blowhole*, a nostril on top of its head. Powerful muscles seal the blowhole while the dolphin is underwater.

Dolphins have a highly developed sense of hearing. They can hear a wide range of low- and high-pitched sounds, including many that are beyond human hearing. Dolphins also have good vision, and the entire surface of their bodies has a keen sense of touch. All these senses function well both above and below the surface of the water. Dolphins have no sense of smell.

Dolphins have a natural sonar system called *echolocation*, which helps them locate underwater objects in their path. A dolphin locates such objects by making a series of clicking sounds. These sounds leave the animal's body through the *melon*, an organ on top of the head. The melon consists of special fatty tissue that directs the sounds forward. Echoes are produced when the sounds reflect from an object in front of the dolphin. By listening to the echoes, the animal determines the location of the object.



Dolphins often travel in large groups called *schools*. A dolphin swims by moving its tail and the rear part of its body up and down. The animal's streamlined shape and smooth skin reduce friction with the water.



Most kinds of dolphins have a large number of teeth. Some species have more than 200. Dolphins use their teeth only to grasp their prey, which are chiefly fish and octopuslike animals called *squids*. Dolphins swallow their food whole and usually eat the prey headfirst.

### The life of dolphins

Most dolphins mate in spring and early summer. The males are called *bulls*, and the females are called *cows*. The courtship behaviour may involve head-bumping. The pregnancy period for most species of dolphins lasts from 10 to 12 months. The females usually give birth to one baby, called a *calf*, at a time. After the calf is born, it swims to the surface for its first breath of air. A newborn dolphin is about a third as long as its mother.

Female dolphins, like all female mammals, have special glands that produce milk. The calf sucks the milk from its mother's nipples. The females nurse and protect their young for more than a year. Male dolphins take no part in caring for the young.

Most species of dolphins live at least to 25 years of age. Some pilot whales reach 50 years of age. Sharks are the chief natural enemies of dolphins.

Some dolphins die after swimming into extremely shallow water and stranding themselves on the shore. The animals cannot live long out of water because their bodies become overheated. Scientists do not know why dolphins beach themselves. Most beached dolphins die from natural causes.

**Group life.** Most knowledge about the living habits of dolphins comes from aquariums and zoos. Killer whales seem to have the closest-knit groups, most of which consist of from several to 17 or 18 animals. Bottle-nosed dolphins live in groups of about 12. Among some species the groups combine and form schools of 100 to 1,000 dolphins.

Adult males and young dolphins move among groups of females with their calves. The animals in such groups play and hunt for food together. They also help other members of the group that are in trouble. Dolphins sometimes use their backs or flippers to keep an ill or injured dolphin near the surface.



A baby dolphin at birth swims to the surface for its first breath of air. The mother nurses its baby with milk for about a year. Dolphins breathe through a *blowhole* on top of the head.

Dolphins communicate with one another in a variety of ways. For example, they may use a complex series of whistles and clicks called *phonations*. The animals make these sounds in air-filled sacs connected to their blowholes. Dolphins also communicate by slapping their flukes on the surface of the water.

**Swimming and diving.** Dolphins swim by moving their flukes up and down. This action differs from that of most fish, which propel themselves through the water by swinging their tail fins from side to side. Dolphins use their flippers to make sharp turns and sudden stops. Killer whales and some smaller species of dolphins can swim at speeds of 32 to 40 kilometres per hour. But they can maintain those speeds for only a short time. Most dolphins swim much slower.

Dolphins do not usually dive deeply, though they have the ability to do so. Some dolphins have been trained to dive more than 300 metres. When a dolphin dives, its lungs collapse and its heart rate slows down. These actions allow the animal's body to adjust to the increasing pressure as the dolphin dives deeper.

### Dolphins and people

The attraction between dolphins and people goes back thousands of years. Ancient Greek artists decorated coins, pottery, and walls with pictures of dolphins, and the animals appear in Greek and Roman mythology. The ancient Greeks considered the common dolphin sacred to the god Apollo. For centuries, sailors have regarded the presence of dolphins near ships as a sign of a smooth voyage.

On the other hand, hunters of several nations, including Sri Lanka and Japan, kill thousands of dolphins annually. The dolphins provide meat eaten by people and animals, and the oil from their bodies is used as a lubricant. In addition, millions of dolphins have drowned in fishing nets that were intended to catch cod, mackerel, salmon, and other kinds of fishes. Tuna fishing crews have been responsible for the largest number of these deaths among dolphins. For some unknown reason, some species of dolphins often swim over large schools of yellowfin tuna. As a result, nets meant to catch tuna trap many dolphins as well. Improved fishing technology and legal restrictions in some countries greatly reduced the number of dolphins killed unintentionally by human beings.

Since the mid-1900's, hundreds of dolphins have been trained to perform in shows presented by aquariums, zoos, and amusement parks. Scientists conduct various types of research on dolphins to understand their complex communication systems.

**Training dolphins.** Most trained dolphins in amusement parks, aquariums, and zoos are bottle-nosed dolphins, though many pilot whales, spotted dolphins, and killer whales also perform in shows. These playful animals sometimes invent new behaviour patterns by watching other dolphins perform. Trained dolphins jump through hoops, throw balls through nets, or "walk" backwards on the water by using their powerful flukes. Some leap 4.6 to 6 metres out of the water to ring a bell or to take a fish from a trainer's mouth.

**Research on dolphins** has mostly concentrated on dolphins' echolocation and communication systems. For example, dolphins that have been blindfolded with suc-



tion cups use echolocation to detect even small differences in the shape, size, and thickness of objects. Scientists have also studied the diving ability of dolphins.

Certain sounds that dolphins make when communicating with one another apparently are associated with specific situations. For example, some zoologists believe dolphins make a particular sound when they are in trouble, though these distress calls vary. Eventually, researchers hope to learn the exact nature of the information that dolphins apparently transmit among themselves.

**Scientific classification.** Marine dolphins make up the family Delphinidae in the order Cetacea. The bottle-nosed dolphin is *Tursiops truncatus*, and the common dolphin is *Delphinus delphis*.

See also **Killer whale; Pilot whale; Porpoise; River dolphin; Whale.**

**Dolphin** is a large game fish that lives in warm salt waters. It is also called *dorado* or *mahi mahi*. The largest dolphins are about 2 metres long and weigh 35 to 45 kilograms. They live in tropical oceans. The dolphin's long body tapers towards a V-shaped tail. It is shimmering bluish-green and silver. The dolphin sometimes chases flying fish at sea for food. Dolphin is good to eat.

**Scientific classification.** The dolphin is a member of the family Coryphaenidae. The most common species is *Coryphaena hippurus*.

See also **Fish** (picture: Fish of coastal waters and the open sea).

**Domagk, Gerhard** (1895-1964), a German doctor, identified the therapeutic ability of the chemical *prontosil rubrum*, the first of the sulpha drugs. He showed that this drug effectively destroyed streptococcal bacteria. These bacteria cause a wide variety of infections, including sore throat, scarlet fever, and impetigo. Domagk won the 1939 Nobel Prize in physiology or medicine for his discovery. Domagk's later publications dealt chiefly with the search for a cancer cure. He was born in Lagow, in Germany.

See also **Sulphonamide** (Development of sulphonamides).

**Dome** is a curved roof erected on a circular base, much like a bowl turned upside down. The earliest domes covered primitive huts and were made of brick or stone. The ancient Romans used domes to top such circular temples as the Pantheon in Rome. The Pantheon has one of the largest masonry domes ever built, with a height and a diameter of 43 metres.

In the early A.D. 500's, the invention of *pendentives*, curved triangular supports, allowed architects to place domes over square buildings. Previously, builders could only construct domes on round buildings. One of the first large buildings to use pendentives was the church of Hagia Sophia in Constantinople (now Istanbul), completed in 537.

Renaissance domes, such as those atop St. Peter's Church in Rome and the Cathedral of Florence, are generally taller than earlier domes. The dome on St. Peter's provided the model for the dome on the United States Capitol building in Washington D.C. and many others. Most mosques and Muslim tombs have domed roofs. The Taj Mahal in Agra, India, is a particularly beautiful example. Architects today use huge domes to cover stadiums such as the Astrodome in Texas, U.S.A.



**The Panthéon dome** in Paris is a masterpiece of the neoclassical style. It was designed in 1755 and completed in 1790.

For illustrations of domes, see **Architecture**.

See also **Cupola; Fuller, Buckminster; Hagia Sophia; Pantheon; Taj Mahal.**

**Dome of the Rock.** See **Jerusalem** (Holy places; picture).

**Domesday Book** was the first official record of the property holders living in England and the amount of land they held. The information was collected and recorded at the command of William the Conqueror in 1086, 20 years after he and his followers from Normandy crossed the English Channel and conquered England. Afterward, the properties of the great English landowners were taken over by William and his followers. William ordered the Domesday survey to discover how much land he owned, how the rest was divided, and how the land was peopled.

The kingdom was divided into districts. Each district supplied census takers who knew the territory. The census and the land survey covered most of the territory William controlled. No survey was held in either London or Winchester, and information about regions in northern England is incomplete. Domesday Book is viewed as the greatest public record of medieval Europe. It is displayed at the Public Record Office in London.

See also **Norman Conquest**.

**Domestic animal.** See **Animal** (The importance of animals).

**Domestic shorthair cat.** See **Cat** (Short-haired breeds).

**Domestic system.** See **Industrial Revolution** (The textile industry).

**Dominance** is a form of behaviour among individual animals that shows their ability to win aggressive encounters with other animals. These animals may be members of the same species or members of different species. Dominance determines which individuals have first choice of resources that are needed to survive and reproduce and that are in limited supply. These resources might include food, water, or mates. Individuals that lose the aggressive encounters or give in to dominant individuals without a fight are called *subordinates*. Subordinates that are denied use of scarce resources may be among the first to die or to leave an area.



In a group, a particular individual may be dominant to some members and subordinate to others. This results in a *dominance hierarchy*—that is, a ranking of individuals by their dominance in relation to each other. In many cases, an individual loses to all those ranked above it and wins against all below it. This type of ranking is called *linear dominance hierarchy*. However, dominance hierarchies may be more complicated. For example, in *circular dominance hierarchy*, individual A may be dominant to individual B and B dominant to individual C, but C is dominant to A. Individuals can change their position in the group's dominance hierarchy as their ability to win fights changes with experience or maturity.

Encounters that establish dominance only occasionally include actual fighting. In most cases, these encounters involve only certain signals that indicate an individual's willingness or ability to win a potential fight. An individual's large size or threatening natural weapons, such as the horns of mountain sheep, might be enough to cause subordinates to give up without a fight.

Dominance differs from *territoriality*, a form of animal behaviour in which an individual or group claims a certain area as its own (see **Territoriality**). A dominant individual can usually win wherever it is.

**Domingo, Plácido** (1941– ), a Spanish tenor, became one of the most popular opera singers of the 1900's. Domingo gained international praise for his performances in lyric and heroic roles in Italian operas. He has also sung a number of major roles in the German operas of Richard Wagner.

Domingo was born in Madrid. He moved with his family to Mexico in 1950 and studied singing at the National Conservatory of Music in Mexico City. Domingo made his opera debut in 1960 in Monterrey, Mexico, as Alfredo in *La Traviata*. Domingo sang with the Israeli National Opera from 1962 to 1965 before becoming a leading tenor with the New York City Opera from 1966 to 1968. He made his debut with the Metropolitan Opera in 1968 as Maurizio in *Adriana Lecouvreur*.

**Dominic, Saint** (1170?–1221), was a Spanish religious leader. Dominic founded the Order of Friars Preachers, also called the Dominican Order. He was born in Calaruega in the Old Castile region of Spain. He studied at the University of Palencia and became a canon at the cathedral of Osma, near El Burgo. Later, he opposed the heretical teachings of the Albigenses.

In 1216, Pope Honorius III gave Dominic permission to establish a new religious order for the purpose of preaching against heresy. By the time of Dominic's death, the order he established had spread throughout Europe. Saint Dominic's feast day is celebrated on August 4.

See also **Albigenses**; **Dominicans**.

**Dominica** is an independent island country in the Caribbean Sea. It consists of one island, located 515 kilometres north of Venezuela. Dominica is the most northerly of the Windward Islands, a group within the Lesser Antilles chain (see **Windward Islands**). It is situated between the French West Indian islands of Guadeloupe to the north and Martinique to the south. Roseau, the capital and chief port of Dominica, lies on the island's southwestern coast, at the mouth of the Roseau River. Roseau has a population of about 11,000 (see **Roseau**).

Dominica is a land of rivers, waterfalls, and towering



**Dominica** is a small island country in the Caribbean Sea. The village of Soufrière, above, lies on the country's southern coast.

mountains set in a landscape of lush vegetation. Because it is volcanic, it also has hot sulphur springs. Boiling Lake is heated by escaping volcanic gases. The island is a tourist venue.

**Government.** Dominica is a republic. The president is officially the country's chief executive but the prime minister is the most powerful officer of the government. The prime minister heads an 11-member cabinet, which conducts the operations of the government. A single-chamber parliament called the House of Assembly makes the nation's laws. It consists of 21 members elected by the people and 9 members, called senators, appointed by the government and the opposition. The legislature elects the president. The prime minister is the leader of the political party with the most seats in the legislature.

**People.** For Dominica's total population, see the **Facts in brief** table with this article. The people who live in Dominica are mostly of African or mixed African, British, and French ancestry. A small number of Europeans, Lebanese, and Syrians also live in the island. About 3,000 Carib live in Dominica. They are descendants of the people who controlled Dominica at the time of the first per-

## Dominica

- National capital
- Other city or town
- + Elevation above sea level
- Road







**Government House** is in Dominica's capital city, Roseau. The city has many fine stone buildings dating from the 1700's, as well as some modern ones.

manent European settlements there in the late 1600's. The Carib live in the Carib Territory, a 1,500-hectare reserve in the northeast of the island.

Most Dominicans who live in cities speak English, the nation's official language. The villagers chiefly speak a French *patois*, which is a mixture of African languages and French. About 80 per cent of the people are Roman Catholics, and almost all the rest are Protestants.

**Way of life.** Most of Dominica's workers are employed either on the land or in service industries such as tourism. Outside working hours, the citizens of Dominica enjoy sports, picnics, visiting friends, and going to dinner and dance clubs. Usually, Dominica's people wear Western-style summer clothes. But Dominica has a national dress for women, called *la robe dwiyet*. It consists of a colourful dress that follows the contours of the body down to the waist and has a full skirt. The skirt is pinned up at several points to reveal a white petticoat trimmed in layers of lace. Accessories include a scarf,

large round earrings, and a brightly coloured headband. Women wear this dress, or its simpler variation, the *jipe* on festive occasions, especially around Dominica's National Day, November 3.

**Food.** Dominica's national dish is *mountain chicken*. Other favourite foods include *calaloo* (spinach), *crab backs*, and *ground provisions* (root vegetables or tubers) prepared in various ways with fish or meat.

**Education.** Dominica has about 66 primary schools and 9 secondary schools. There is also one institute of post-secondary education, serving as a teacher training college, a vocational training centre, and a sixth-form college.

**Arts.** Dominica, for many years the object of rivalry between the United Kingdom and France, has a culture that has elements of both an English and French tradition. Most place names are French, but the official language is English.

Popular events include performances of traditional dances and of the *conte* (story-telling). The state of Dominica supports the preservation of these activities through a series of nationally organized competitions, leading up to the celebration of National Day (November 3). The Cultural Division, a department of the government of Dominica, is responsible for organizing these events. Annual cultural activities include colourful pre-Lenten carnivals, with their parades and contests.

**Land and climate.** Dominica covers an area of about 751 square kilometres. It is a mountainous, tree-covered island formed by volcanic eruptions. Some mountains in the north and south rise over 1,200 metres. Morne Diablotin, the highest peak in Dominica, is 1,447 metres above sea level.

The rugged wooded interior of the island has long remained inaccessible. There is flat land on parts of the coast. The country has many rivers, but most are too rough to be used by boats other than canoes.

### Facts in brief about Dominica

**Capital:** Roseau.

**Official language:** English

**Official name:** Commonwealth of Dominica.

**Area:** 751 km<sup>2</sup>. **Greatest distances**—north-south, 47 km; east-west, 26 km. **Coastline**—148 km.

**Elevation:** **Highest**—about 1,447 m in Morne Diablotin.

**Population:** **Estimated 1996 population**—71,000; density, 95 people per km<sup>2</sup>; distribution, 20 per cent urban, 80 per cent rural. **1991 census**—71,794. **Estimated 2001 population**—75,000.

**Chief products:** **Agriculture**—citrus fruit, passion fruit, root crops, coffee, bananas, cut flowers. **Manufacturing**—fruit juices, bottled spring water, rum, furniture, garments, electronic assembly.

**National anthem:** Untitled.

**Money:** **Currency unit**—East Caribbean dollar. One dollar=100 cents.



The volcanic nature of Dominica has given rise to many hot sulphurous springs and volcanic vents in the island. Hot gases escape from such a vent and bubble up through the waters of Boiling Lake, a body of water situated 701 metres above sea level. This is one of the largest and most spectacular lakes of this kind in the world.

Temperatures in Dominica seldom rise above 32 °C or fall below 18 °C. The daytime average is 27 °C. Annual rainfall is heavy and ranges from about 100 centimetres in Roseau, on the southwest coast, to about 630 centimetres high up in the mountains.

**Economy** of Dominica is based on agriculture. More than 60 per cent of the people work on farms, and most of the rest process agricultural products. Agriculture contributes nearly 60 per cent of Dominica's *gross domestic product* (GDP, the value of all the goods and services produced within the country in a year). Bananas are the country's chief product and export. Other products and exports include *ground provisions* (roots and tubers), coconuts, and coconut by-products.

Manufacturing, mining, retail trade, and tourism are among the many minor economic activities. Tourism, along with banking services, has increased in importance since the 1970's. Service industries contribute more than half of the country's GDP. The United Kingdom is Dominica's chief international trading partner.

**History.** The Arawak, Dominica's first inhabitants, settled there about 2,000 years ago. The Carib took over the island about 1,000 years later. On Nov. 3, 1493—a Sunday—Christopher Columbus became the first European to sight the island. He named it Dominica, after the Latin phrase *Dies Dominica*, which means *Sunday*.

Probably because of the opposition of the Carib, the Spaniards never tried to settle in Dominica. French and British settlers began to arrive there in the 1600's. For many years, the Carib, British, and French fought for control of the island. The British gained permanent possession of it in 1805. They shipped African slaves to Dominica as plantation workers. Slavery was ended in 1834. From 1871 to 1939, Dominica and other British islands to the north were part of the Leeward Islands Federation. Dominica was transferred to the Windward Islands in 1940. From the 1930's to the 1970's, the United Kingdom gradually increased Dominica's control over its own affairs. Dominica gained independence on Nov. 3, 1978.

In 1979, a major hurricane struck Dominica. It killed more than 50 people and caused much damage. In 1983, Dominica and several other Caribbean nations joined the United States in an invasion of Grenada, another West Indian country, to overthrow a Marxist government there (see *Grenada* [History]). The Dominica Freedom Party (DFP) came to power in 1980 under prime minister Dame Eugenia Charles. In elections in 1995, following Dame Charles' resignation, the DFP was defeated by the United Workers' Party (UWP). Edison James became prime minister. The president of Dominica is Crispin Sorhaindo.

See also *Roseau*.

**Dominican Republic** is an independent country in the West Indies, a region of the Caribbean Sea. It occupies the eastern two-thirds of Hispaniola, the second largest island in the Greater Antilles. The remainder of

the island is occupied by the republic of Haiti.

Hispaniola lies between the islands of Cuba and Puerto Rico and is located about 1,000 kilometres south-east of Florida, United States. It is the second largest island in the whole of the Caribbean region. Only Cuba is bigger. For information about Hispaniola and its location, see *Hispaniola*. See also *Haiti*.

The Dominican Republic is a land of fertile valleys and wooded mountains. It is a centre for both tourism and agriculture. The republic's capital, Santo Domingo de Guzman, lies in the southern coastal region. It is the country's main port and the longest surviving European settlement in the Western Hemisphere. It is also famous for having the first institution of higher learning in the region, the Autonomous University of Santo Domingo, founded on Oct. 28, 1538. The city is also home to the first cathedral built in the Americas. It was founded in 1514.

### Government

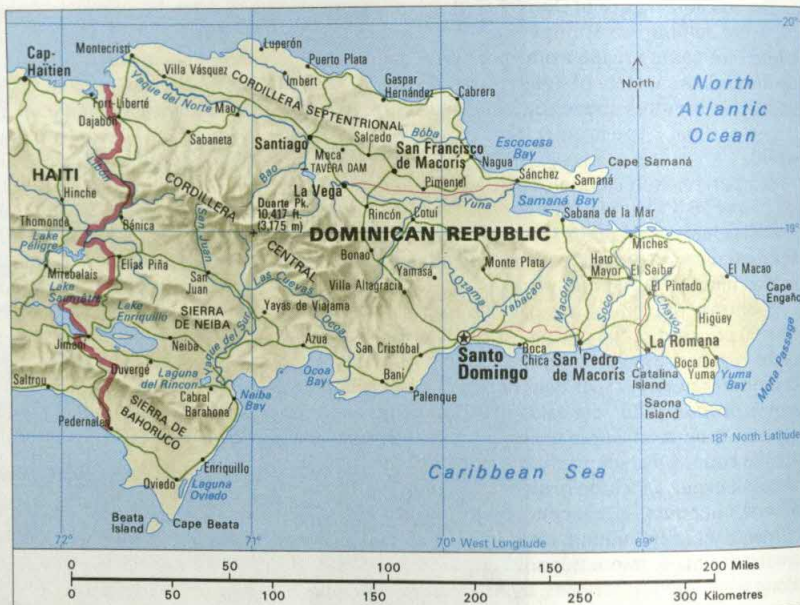
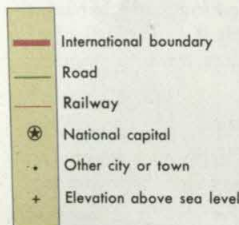
Under its 1966 Constitution, the Dominican Republic has a representative, democratic system of government consisting of a presidency and a *bicameral* (two-chambers) Congress or parliament. The Congress in turn is made up of the Senate or Upper House and the Chamber of Deputies. The Senate consists of 30 elected members. The Chamber of Deputies has 120 elected members. For the purposes of local government, the republic is divided into 31 provinces together with the Na-



A statue of Christopher Columbus stands in the Plaza Colón in Santo Domingo, the capital of the Dominican Republic.



## Dominican Republic



tional District of Santo Domingo. Each of these divisions has its own senator and is run by an elected council. Elections are held every five years.

### People

**Population and ancestry.** For the population of the Dominican Republic, see the *Facts in brief* table with this article. About 50 per cent of the people live in the cities and towns and 50 per cent inhabit the small rural farming communities of the republic. About 30 per cent of the population live in Santo Domingo, and 7 per cent inhabit the other major city and industrial centre, Santiago de Los Caballeros.

About 11 per cent of the population are African, 16 per cent European, and 73 per cent are of mixed African and European origins. The official language of the Dominican Republic is Spanish. However, because a high

proportion of the country's people are immigrants from Haiti, a French *creole* is widely used.

### Way of life

In the Dominican Republic, many country people work mainly on *smallholdings*, tiny farms on which they grow their own food. They sell any surplus produce in order to buy clothes and other goods. Others are tenant farmers or farm labourers working for the owners of large sugar cane, coffee, and *cacao* (cocoa-bean) plantations. Those who own small farms tend to live in two-room shacks with thatched roofs. Government-built bungalows are slowly replacing these shacks.

Most city-dwellers earn a living as factory workers or government employees, or by fishing. Some find work related to the tourism industry. Many live in crowded old Spanish-style apartment buildings. They wear Western-style clothes.

A large number of people work in mining and other industries. Many of these industries have been set up in areas called *free zones*, or *free-trade zones*. These are specially designated regions of the country in which employers can enjoy certain government aid, usually in the form of tax advantages, on condition that they employ local labour and that their products are exported.

**Recreation.** Music is very popular in the Dominican Republic. People enjoy a style of music that blends the rhythmic beat of African drums with Spanish and Latin American elements. The national dance is the *merengue*. Other popular dances are the *carabine* and the *bolero*.

People in the Dominican Republic enjoy sport. The leading sporting activities are baseball and basketball. These particular sports, which are also popular in Puerto Rico, demonstrate the strong U.S. influence on this area of the Caribbean.

**Culture.** Citizens of the Dominican Republic have a strong sense of history, nationalism, and cultural

### Facts in brief about the Dominican Republic

**Capital:** Santo Domingo.

**Official language:** Spanish.

**Form of government:** Republic. *Head of state*—President.

**Area:** 48,734 km<sup>2</sup>. *Greatest distances*—east-west, 388 km; north-south, 274 km. *Coastline*—972 km.

**Elevation:** *Highest*—Duarte Peak, 3,175 m above sea level.

*Lowest*—Lake Enriquillo, 46 m below sea level.

**Population:** *Estimated 1996 population*—8,050,000; density, 165 people per km<sup>2</sup>; distribution, 60 per cent urban, 40 per cent rural. *1981 census*—5,647,977. *Estimated 2001 population*—8,749,000.

**Chief products:** *Agriculture*—avocados, bananas, cacao, coffee, mangoes, rice, sugar cane, tobacco. *Mining*—gold, nickel. *Manufacturing*—molasses, sugar.

**National anthem:** "Himno Nacional."

**Flag:** A white cross divides the *national flag*, flown by the people, into alternately red and blue quarters. Blue stands for liberty, white for salvation, and red for the blood of heroes. The *state flag*, used by the government, has the Dominican coat of arms in its centre. See **Flag** (picture: Flags of the Americas).

**Money:** *Currency unit*—Dominican peso. One peso = 100 centavos.





**Santiago de los Caballeros** lies on the banks of the Yaque del Norte River and is the Dominican Republic's second largest city.

identity. The country boasts several monuments and museums. The Columbus Lighthouse was opened in 1992 to mark the 500th anniversary of Christopher Columbus' arrival in the region. Other sights of importance are the Museum of the Dominican Man, the Museum of the Home, and the Casas Reales (Royal Houses). The Roman Catholic cathedral of Santo Domingo, the Catedral Basílica Menor de Santa María, Primada de América, dates from 1514. It was the first cathedral to be founded in the Western Hemisphere. Another famous building in Santo Domingo is the Alcázar of Don Diego Colón, the *palacio* (residence) of the son of Christopher Columbus. He was the Spanish viceroy of the West Indies for 15 years, from 1509 until his death in 1526.

Through its museums and a comprehensive programme of restoration work, the Dominican Republic seeks to preserve and exhibit representative treasures of its historical heritage in a systematic manner.

Regular cultural events in the Dominican Republic include the New Year Grand Fiesta, which takes place along the bay front at Santo Domingo; the Day of Our Lady of Altagracia, held on January 21 in honour of the Virgin Mary; and Restoration Day, on August 16. Carnivals take place on February 27, in celebration of the republic's independence. A Merengue Festival Week takes place each July in Santo Domingo, and a similar event is staged each October at Puerto Plata.

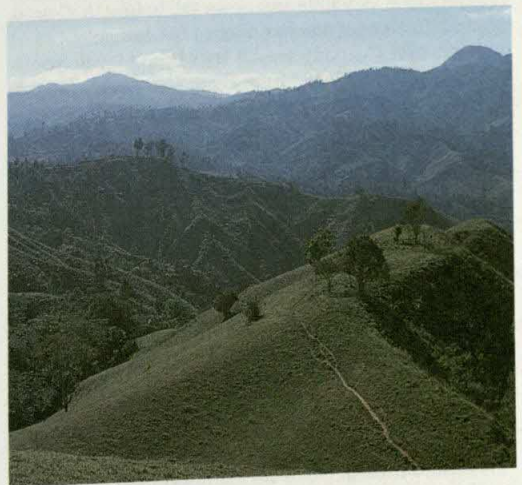
**Education.** The education system of the Dominican Republic has traditionally been well served by primary and secondary schools. Education is completely compulsory in the Dominican Republic for the first eight years of a child's school career. For economic reasons, many children from low-income families drop out of the education system before entering secondary school. Nevertheless, nearly 20 per cent of students enter the Dominican Republic's eight universities. During the 1980s, economic difficulties forced the republic's government to cut back its education spending. But in the 1990s the government was seeking to provide education for a larger number of citizens through programmes aided by the World Bank.

**Religion.** Roman Catholicism became the state religion of the Dominican Republic in 1954, when the government signed a special agreement called a *concordat* with the Vatican. The population is 95 per cent Roman Catholic, but the country tolerates other Christian denominations, including Baptists, Evangelicals, and Seventh-Day Adventists.

#### Land and climate

The Dominican Republic occupies an area of 48,422 square kilometres. It shares a 150-kilometre border with Haiti on the west and is separated from its island neighbour, Puerto Rico, by the Mona Passage, to the east.

It is a mountainous country. The *Cordillera Central* (Central Mountain Range) runs from northwest to southeast through the middle of the land. Pico Duarte, which rises to 3,197 metres above sea level in the Cordillera Central, is the highest point in the West Indies. Other



**The Dominican Republic's** Vega Region includes parts of the scenic mountain backbone.



**Salt mining** makes a small contribution to the economy of the Dominican Republic. The salt is laid out in raised beds to dry in the sun.



notable peaks are La Pelona (3,176 metres), Yaque (2,995 metres), and Loma del Maco (2,286 metres).

The land to the west of the Cordillera Central is mostly dry and semidesert. The Sierra de Neiba and the Sierra de Bahoruco are mountains in the west of the republic. Lake Enriquillo, a saltwater lake 46 metres below sea level, is the lowest lake in the West Indies. It lies between the two sierras.

The *Cibao* lies north of the Cordillera Central. The Cibao is an area of pine-covered slopes and a fertile plain called the *Vega Real* (Royal Plain). It is the country's chief agricultural area. The *Cordillera Septentrional* is in the far north.

The eastern end of the Dominican Republic is less mountainous. Most of the nation's sugar cane is grown in the east and along the southeastern coast.

The Dominican Republic has a warm, tropical climate. Temperatures vary little and never fall below 16 °C or exceed 32 °C. The country has about 150 centimetres of rain annually. The rainy season lasts from May to November in the south and from December to April in the north. Hurricanes sometimes strike the republic.

### Economy

**Agriculture.** The Dominican Republic is an agricultural country, with about 40 per cent of the working population employed on the land. The bulk of the republic's agricultural products come from large plantations owned by wealthy individuals or by the government. The broad, fertile plains are heavily farmed to produce avocados, bananas, mangoes, oranges, rice, sugar cane, and tobacco. In the wooded foothills of the mountains, coffee and cacao (the plant that yields cocoa beans for making cocoa and chocolate) grow in the shade of fruit and mahogany trees. Farmers in the north also rear livestock for meat and other products.

**Manufacturing.** The main manufacturing activities are the processing of agricultural products, especially the refining of sugar for export. A large proportion of

the sugar cane is exported. The remainder is consumed within the republic or turned into molasses and rum. Since 1990, sugar refining has become less important following a decline in sugar exports, especially to the United States. Other manufactured goods include cement and textiles.

**Mining.** Nickel, gold, silver, and *bauxite* (an ore of aluminium) are the chief mining products of the Dominican Republic. The republic ranks ninth in the world for nickel production. The country's quarries also produce gypsum, limestone, and salt.

**Service industries.** The most important service industry is tourism. Together with mining, tourism is now the Dominican Republic's highest earner of foreign currency. The Dominican Republic has numerous tourist-based resources. Among them are the long coastline and its attractive beaches. Another is the Cibao region in which is located the Santo Cerro—Holy Mount—which overlooks the Valley of La Vega Real. Here Columbus is said to have planted a cross, given to him by Queen Isabella before his departure to the New World. This area, also known for its beauty, has become a place for pilgrimage. Another attraction is Lake Enriquillo.

The country's main commodity exports are cocoa, coffee, minerals, sugar, and tobacco. Tourism and offshore data processing (record-keeping for foreign companies) are the chief service exports. The main countries to which the Dominican Republic exports its products are the United States and the Netherlands. The republic imports food items, industrial raw materials, and capital goods such as office equipment from the United States, Japan, Germany, Venezuela, and Mexico.

**Transportation and communication.** The Dominican Republic has a good road network, estimated at more than 17,000 kilometres. It has 150 radio stations and 7 television stations, some owned by the state, others in private hands. The state-run national telephone company *Compania Dominicana de Telefonía* (CODETEL) provides modern telephone, fax and electronic mail





**Santo Domingo's architecture** reflects Spain's long dominance of the Dominican Republic. The fortress on the left was built to protect Spanish interests.

services, and cellular radio services for mobile telephones. There are about nine newspapers. The *Listin Diario*, founded in 1889, is the oldest independent newspaper in the region.

### History

A people known as the Taino Arawak migrated to Hispaniola probably from South America long before Christopher Columbus landed there. Columbus claimed the island for Spain on Dec. 6, 1492. At the end of what had been his first voyage to the New World, his flagship *Santa Maria*, ran aground on the northern coast, and its timbers were used to construct Fort Navidad. Columbus left a garrison of 1,300 men to hold the fort while he sailed on. These men quarrelled with the Arawak and were killed by them.

News of gold in what is now the Dominican Republic drew thousands of Spanish colonists to Hispaniola. They defeated and enslaved the Arawak. The colonists founded several towns, including La Nueva Isabela (later renamed Santo Domingo) in 1496.

By the mid-1500's, almost all the Arawak had died from maltreatment and disease, and the gold had become hard to find. Most of the Spanish settlers moved on to seek gold in Cuba, Mexico, and Peru. Hispaniola was left with only about 2,000 Spanish inhabitants and produced little of value. In 1606, the Spanish government ordered all its colonists to move close to Santo Domingo in order to strengthen the town and provide a trading base for Spanish merchants.

British, Dutch, and French pirates invaded and occupied parts of the western end of the island, and the Spaniards were unable to dislodge them. By the Treaty of Ryswick (1697), Spain formally ceded the westernmost third of Hispaniola to France. During the 1700's, the new French colony of Saint Domingue prospered, as French landowners introduced a plantation system worked by imported African slave labour. Meanwhile, the rest of Hispaniola suffered from poverty and neglect by Spain.

After a slave uprising, Saint Domingue threw off French rule and became the independent republic of Haiti in 1804. In 1821, the eastern two-thirds of Hispaniola won its independence from Spain and became the Dominican Republic. Within a year, Haiti overran the Dominican Republic and took control of it.

In July 1838, Juan Pablo Duarte, the "Father of Dominican independence", founded a secret resistance movement called La Trinitaria (the Trinity). With Francisco del Rosario Sánchez and Ramón Mella, Duarte led a successful revolt against the Haitians in 1844. The republic had won its independence, but civil unrest, unstable and undemocratic government, and the ever-present threat from Haiti hampered its early development.

From 1861 to 1865, Spain governed the country at the request of the Dominican Republic to protect it from the Haitians. In 1870, the republic tried but failed to obtain the protection of the United States. From 1882 to 1899, the dictator Ulises Heureaux governed the country. He built roads and took the first real steps in modernizing the Dominican Republic. He was assassinated in 1899.

The United States took over the collection of customs duties in the Dominican Republic from 1905 to 1941 and used the money to pay the republic's debts. From 1916 to 1924, U.S. Marines occupied the Dominican Republic to keep peace between rival political groups.

In 1930, Rafael Leonidas Trujillo Molina seized power in a military coup. He ruled the country harshly for 31 years. The republic prospered economically, but Trujillo allowed the people little freedom and imprisoned or killed his opponents. Although Trujillo carried out some beneficial projects, such as the rebuilding of Santo Domingo after a hurricane in 1930, most citizens of the Dominican Republic saw few benefits because all the profits and high offices of state went to members of the Trujillo family.

In 1960, President Rómulo Betancourt of Venezuela was the target of an unsuccessful assassination attempt. Evidence suggested that Trujillo was involved in the





The fruit market in Santo Domingo sells bananas and other produce grown in the Dominican Republic's fertile plains.

crime. The Organization of American States (OAS) imposed an economic embargo upon the Dominican Republic that lasted for two years.

Conspirators murdered Trujillo in 1961. After a period of political turmoil, Juan Bosch and his Dominican Revolutionary Party (PRD), promising social reforms, won the country's first democratic presidential election in December 1962. After seven months, a military coup overthrew Bosch's government.

In 1965, an uprising against the conservative government occurred, and rebels captured Santo Domingo. Fearing a Communist takeover in the Dominican Republic, the United States again sent in occupying troops to control the situation. In June 1966, voters elected Joaquín Balaguer of the Social Christian Reformist Party (PRSC) as president. Balaguer, who had held office under Trujillo, was regarded as a conservative but he brought the country stable government at last. Balaguer retained power until 1978, when he was defeated by Antonio Guzmán of the PRD.

In 1979, Hurricane David ravaged the Dominican Republic and badly damaged the economy. In 1982, the PRD's Salvador Jorge Blanco won the presidency. Before Jorge Blanco took office, his predecessor Guzmán committed suicide.

Jorge Blanco set up an Adjustment Programme to try to halt the deterioration in the economy. But his measures led to soaring food prices, and there were riots in 1984. Jorge Blanco lost the 1986 election to Balaguer. Balaguer sought to improve the economy through public works programmes. Although he achieved short-term gains, he failed to tackle the underlying problems of high inflation and inadequate services. Nevertheless, he won the presidential elections of 1990 and 1994.

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**Dominicans** are members of a Roman Catholic religious order founded by Saint Dominic of Spain in the early 1200's. The official name of the order is the Order

of Friars Preachers. Dominicans have become noted as preachers, teachers, and missionaries. They were the first major order to emphasize intellectual work. Previous orders had concentrated on manual labour. Within a generation of their founding, Dominicans staffed theological departments of major universities. Famous members of the Dominican order include Saint Albertus Magnus, Saint Catherine of Siena, and Saint Thomas Aquinas.

Today, the Dominican order consists of about 106,000 men and women. It is comprised of friars, priests, nuns, sisters, as well as members of the *secular institutes* and the *laity*. Members of secular institutes live in the community but have taken religious vows. Members of the laity follow Dominican teachings but have not taken religious vows.

The Dominicans are divided into three orders. Men called *friars* make up the First Order. The Second Order consists of *nuns* (women who lead lives devoted to spiritual meditation). The Third Order has many subdivisions and includes both men and women. The Dominicans are headed by a *Master General*. The order's headquarters are in Rome.

Dominic founded the Second Order in 1206 and the First Order in 1216. He established the Dominicans to oppose a religious group in southern France called the Albigenses. Throughout the history of the order, the popes have used Dominicans for special missions, such as diplomatic service and preaching support for the Crusades during the Middle Ages. For centuries, Dominicans were among the leading members of the staff of the Inquisition (see *Inquisition*). The chief theologian for the papal household has been a Dominican since the founding of the order.

See also *Albertus Magnus*, *Saint*; *Aquinas*, *Saint*; *Thomas*; *Catherine of Siena*, *Saint*; *Dominic*, *Saint*; *Eckhart*, *Johannes*; *Friar*; *Nun*.

**Dominoes** is the name of several games played with small, flat, oblong pieces called dominoes. Dominoes were probably invented in China, and introduced in Europe in the 1300's. Most sets of dominoes are made of bone, ivory, plastic, or wood. A regular set consists of 28 dominoes. A line divides each domino into two sections. Each section of 21 of the 28 dominoes is marked with from one to six dots. Both sections on one domino are blank, and six dominoes have one blank section and one section with dots.

The simplest domino game is called the *block* game. In this game, the players first place all the pieces face down and mix them well. Then each chooses a certain number, usually seven if there are two playing, or five if there are three or four. The player with the highest *double domino* (piece with matching sections of dots) usually plays first. Suppose it is the 4-4. The player on the left plays next by matching any domino with four dots in one section to the 4-4 domino. For example, the matching domino may be the 4-6. The following player may then match a section with six dots to the 4-6 domino, or a section with four dots to the 4-4. *Single dominoes* (pieces with different sections of dots) are placed end to end. Double dominoes are placed at right angles to the line of pieces. Plays can be made on either end of a single domino. Plays can be made on both sides of a double, but not on the ends.



If the players cannot match from the dominoes they have chosen, they draw from the pile that remains until they find one that will match. After the pile is used, players who cannot match must miss a turn, or *pass*.

The game ends when one player runs out of dominoes or when no player can match any of the remaining dominoes with those he or she still holds. A player who runs out of dominoes scores points equal to the number of dots on the other players' pieces. If no one runs out, the player with the fewest dots on his or her unplayed dominoes scores the difference between this number and the total number on the opponents' unplayed dominoes. In most games, the first player to reach 100 points wins.

**Domitian** (A.D. 51-96) succeeded his brother Titus as Roman emperor in A.D. 81. His father Vespasian had been emperor from A.D. 69 to 79. Domitian spent his youth studying Roman history. When he became emperor, he tried to restore old standards of conduct and religion. He settled a war with Dacia (now Hungary and Romania) by compromise. To improve agriculture, he cut down on grape production to raise bigger grain and food crops. During his reign, people of other religions, such as Christians and Jews, were executed. His absolute rule made him unpopular. He was assassinated, with his wife's help.

**Don Juan** is the hero of one of the most famous legends in literature. The legend originated in Europe during the Middle Ages. Its form became established in *The Deceiver of Seville* (1630), a play by the Spanish author Tirso de Molina. In this work, the handsome nobleman Don Juan Tenorio tries to seduce the daughter of Don Gonzalo, the knight commander. Don Gonzalo challenges Don Juan to a duel, and is killed by the hero. Don Juan visits the commander's tomb and scornfully invites the statue of his victim to dinner. The statue appears at the feast and returns the invitation, which Don Juan accepts. In the graveyard, the statue takes Don Juan's hand and drags him down into hell.

The complex personality of Don Juan has fascinated writers and composers for hundreds of years. He has appeared in plays by Molière and George Bernard Shaw, an opera by Mozart, and a poem by Lord Byron. José Zorrilla's *Don Juan Tenorio* (1844) is the most popular treatment of the theme in modern Spanish literature. Each interprets Don Juan's personality differently.

**Don Quixote** is a novel by Miguel de Cervantes of Spain. Cervantes published the novel in two parts, in 1605 and 1615. Until the 1800's, *Don Quixote* was thought of as a humorous story of a madman's adventures. Then, it became a model for a new type of fiction with heroes who do not conform to their times.

The hero of *Don Quixote* is a Spanish landowner who enlivens his monotonous life by reading fictional tales about knights of old, which he believes to be true and accurate. Wishing to live like the knights, he takes the name Don Quixote of La Mancha, dresses in armour, and sets out to gain fame by performing heroic deeds. He attacks windmills he thinks are giants and flocks of sheep he mistakes for armies. The peasant Sancho Panza serves as Don Quixote's *squire* (attendant) during the hero's adventures. Small, round Sancho riding his donkey contrasts with the tall, thin Don Quixote on his scrawny horse Rocinante. Sancho stands for the real in



Drawing (1955) by Pablo Picasso

**Don Quixote and Sancho Panza**, one of them lanky and the other squat, have been popular subjects in art for centuries.

life, Don Quixote for the ideal. Their conversations together make up a large part of the novel.

Although beaten and scorned, Quixote still believes in his heroic destiny. When part two of the novel begins, he is amazed to discover that the first part of his life has been published. He must now live up to his literary fame. He loses faith in his destiny, becomes a prisoner of his imagined reputation, and is forced to behave as if he really believed in himself as a hero. Quixote finally regains his senses before he dies.

See also **Spanish literature** (The 1600's).

**Don River** is an important waterway in southwestern Russia. The Don rises from a small lake near Tula. It flows south for 1,963 kilometres and empties into the Sea of Azov. Large ships can sail on the Don for about 1,300 kilometres. A canal connects the Don and Volga rivers at a point where the rivers are only 60 kilometres apart. The northern part of the Don River flows through wooded, swampy land. But most of the river course is through rich farm and timber lands.

The Don carries shipments of timber, grain, and cattle. It also has valuable fish, especially sturgeon. The city of Rostov is near the mouth of the Don. The chief branch of the Don is the Donets.

**Donahoe, Jack** (1806-1830), an Australian bushranger, is known for the exploits recorded in the song "Bold Jack Donahoe" and later incorporated in the ballad "The Wild Colonial Boy." Born in Dublin, Ireland, he was convicted in 1823 of "intent to commit a felony" and transported to Sydney. He worked as an assigned servant and in a road gang. In 1827, with two other men, Donahoe robbed several bullock carts on the Windsor Road. The three men were caught and sentenced to death, but Donahoe escaped. For two years, he lived as a bush-



ranger with various gangs around Sydney. Mounted troopers finally shot him dead near Campbelltown.

**Donatello** (about 1386-1466), was a great Italian sculptor. He was a master of all the techniques and materials of sculpture, and seemed able to handle any subject in the most striking manner.

Donatello was born in Florence, and served as assistant to sculptor Lorenzo Ghiberti. From 1416 to about 1420, he carved the marble statue of *St. George* and the relief below it, *St. George Killing the Dragon* (see *Dragon* (picture)). The saint stands relaxed, as if deep in thought—an ideal example of the Christian knight. The remarkably flat relief shows an extensive landscape.

Donatello's effective use of realism appears in the statue of a prophet, known as *Lo Zuccone* (*The Pumpkinhead*), which he created about 1425. Late in life, Donatello began distortion as he tried to show even more realistic emotional expression.

Donatello did three well-known statues of *David*. One of them is reproduced in the *Sculpture* article. His bronze *David* from the 1430's shows the influence of classical Greek sculpture on his own style (see *Renaissance* (picture: Donatello's *David*)). Donatello's other famous works include the bronze *equestrian monument* (man on horseback) of the Italian general *Gattamelata*. Donatello created the monument in Padua between 1443 and 1453.

See also *Sculpture* (Early Renaissance).

**Doncaster** (pop. 284,300) is a local government district in South Yorkshire, England. It is centred on the industrial town of Doncaster. The district of Doncaster has extensive areas of open countryside and many attractive villages. Agriculture and coal mining are important industries in the district.

Doncaster town, which stands on the River Don, is an engineering centre. Its main products include agricultural machinery, brass and electrical goods, and wire and wire ropes. Nearby lies the racecourse on which the *St. Leger*, an important classic horse race, is run.

See also *Yorkshire*.

**Donegal** is a county on the northwest coast of Ireland. It is one of the three counties of the province of Ulster that are not in Northern Ireland. Only a narrow strip of land connects Donegal to the Republic of Ireland, making it more isolated than any other county.

Donegal is a large and varied county. It is well known for its beautiful scenery and its tweed cloth. Letterkenny is the largest town.

**People and government.** Donegal's population in 1986 was 3 per cent higher than it was at the previous census in 1981. This growth took place throughout the



Marble sculpture (c. 1415); Museo Nazionale, Florence

Donatello's *St. George*

## Facts in brief about Donegal

**Population:** 1991 census—127,994.

**Area:** 4,830 km<sup>2</sup>.

**Largest towns:** Letterkenny, Buncrana, Ballyshannon, Ballybofey-Stranorlar, Donegal, Killybegs, Carndonagh, Bundoran.

**Chief products:** *Agriculture*—barley, cattle, milk, oats, pigs, potatoes, sheep. *Manufacturing*—clothing, fish products, health-care goods, telecommunication equipment, tweed and other textiles.

**Origin of name:** From the Irish *Dun na nGall* (fort of the foreigners).

county but was greatest around Letterkenny. Until the 1970's, the population had declined as a result of emigration. Many people have moved between Donegal and Scotland in particular. Nearly 4 out of 5 people in Donegal live in rural areas. Many people live on the west coast.

About 87 per cent of the people of Donegal are Roman Catholic. People of other denominations belong mainly to the Church of Ireland, the Presbyterians, or the Methodists. Most of the Protestants live in east Donegal. Most of Donegal lies in the diocese of Raphoe. But the Inishowen Peninsula is located in Derry diocese. Each diocese has its own Roman Catholic bishop. For Protestants, the two dioceses are united under one bishop.

The Gaeltacht, the part of Ireland in which people use the Irish language in everyday life, extends over a wide area in west Donegal and has a population of about 26,000. Elsewhere in the county English is the everyday language. Donegal has much folklore, and some traditional features of life survive. The most notable is the summer pilgrimage to Lough Derg in the southwest, a custom dating back to medieval times.

Donegal has two political constituencies, which together elect six members of parliament to *Dáil Éireann* (the lower house of the Republic of Ireland's parliament). A county council is in charge of local government, with its headquarters in the small town of Lifford. Buncrana, Bundoran, and Letterkenny are urban districts. The small seaside town of Donegal, which was once the capital of the county and gave it its present name, is no longer a centre of administration.



**County Donegal** is bordered on the north, the west, and part of the south by the Atlantic coastline.





**Letterkenny** is the largest town and chief industrial centre in County Donegal. It is also the cathedral diocese of the Roman Catholic diocese of Raphoe. St. Eunan's Cathedral, *left*, was built between 1890 and 1901.

**Economy.** One-fifth of the people in Donegal work in agriculture. The Foyle and Finn valleys in the east have fertile soils. Farmers in the east and north grow barley, oats, and potatoes as their main crops. Donegal produces more oats and potatoes than any other county. But the main type of farming is cattle-rearing, with sheep-rearing in upland areas. Some farmers are involved in dairying and the raising of pigs and poultry. Most farms are less than 30 hectares in size. The larger ones are in east Donegal. In the west, there are tiny holdings on infertile land. Only one-third of the county consists of improved agricultural land.

The manufacturing industry has for long been more important in Donegal than in most other parts of the Republic of Ireland. It accounts for more than one-fifth of the county's employment. Nearly half the people of Donegal work in the textile and clothing industries, and these have traditionally been the major areas of economic activity. Donegal is famous for handmade tweed and knitwear. Other industries include fish and other food processing and the manufacture of healthcare products and telecommunications equipment.

Nearly half of the people of Donegal work in service industries, including retailing, defence, education, health, public administration, tourism, and transport. There is a regional technical college in Letterkenny.

Two hydroelectric power stations are on the River Erne in the south, and a small one is on the River Clady in the west. Nearby at Gweedore is a small peat-fired plant. Peat for fuel is cut from the extensive bogs.

Donegal is the most important area for seafishing in the Republic of Ireland. Fishermen land a quarter of the national catch at the leading port of Killybegs, where many industries are associated with fishing. Other fishing ports include Burtonport, Downings, Greencastle, Moville, and Rathmullen. Herring and mackerel fishing are especially important at Killybegs. Among other fish caught in Donegal are cod, crabs, dogfish, haddock, lobsters, plaice, and whiting.

**Communications.** The national primary roads N13 and N15 in east and south Donegal connect Letterkenny and Lifford with Derry and Sligo. The west of the county

is served by the N56. The roads follow the coast and valleys. There is no railway in Donegal.

**Tourism** is important throughout Donegal and especially in coastal areas. People enjoy the beautiful mountain and coastal scenery and the excellent beaches. Bundoran is a major seaside resort. Glenveigh National Park and Ards Forest Park are in the northwest of the county. Many visitors come from Northern Ireland, and some own second homes in Donegal.

**Land.** The long and indented Atlantic coastline on the north, the west, and part of the south of the county forms much of Donegal's boundary. Most of its inland boundary is the border with Northern Ireland.



**Slieve League**, in the western part of County Donegal, has some of the most spectacular cliffs in the whole of Ireland.



The uplands and the rugged coast give Donegal its scenic beauty. The uplands include the Derryveagh Mountains in the northwest and the Blue Stack Mountains in the south. The highest peak is Errigal (752 metres high). It consists of the hard mineral quartzite. Other ancient rocks in the region are granite, schist, and gneiss. There is limestone in the southeast. During the Ice Ages, glaciers were away the uplands, leaving valleys and lakes. The bare rock is now mostly covered with peat. The glaciers carried soil and rock to a lowland area in the southeast. This soil rock came to form the small hills called *drumlins*. The River Erne is in this area. The other main lowland area comprises the valleys of the Foyle and Finn rivers in east Donegal.

The uplands extend to the coast in the southwest, where spectacular sea cliffs, rising 600 metres from the Atlantic Ocean, are the highest in Ireland or Britain. The varied coastline also has more extensive beaches than any other Irish county. The coast is deeply indented in the north, where the Inishowen Peninsula separates the long inlets of Lough Swilly and Lough Foyle. Malin Head, the most northerly point in Ireland, is on this coast. Among the many offshore islands on the west coast are those of Aran and Tory.

The average inland January temperature of about 4° C in Donegal is lower than elsewhere in the Republic of Ireland. But the temperature is warmer on the coast. The July average is 14° C. The annual rainfall ranges from 100 centimetres on the lowlands to 200 centimetres on the higher mountains.

**History.** Many monuments in Donegal date from Stone Age times. The ancient name of the kingdom that occupied much of the present Donegal during the Middle Ages was Tirconail (spelled Tyrconnell in English), meaning *Land of Conall*. Conall was the name of the Irish king who according to legend ruled the area during the A.D. 400's. The descendants of Conall became the O'Donnells. Inishowen and Tyrone belonged to the O'Neills, who were descended from Eoghan, reputed brother of Conall. Rivalry between the O'Donnells and the O'Neills dominated the history of northwestern Ireland for 1,000 years. The headquarters of the O'Donnells was at Grianan of Aileach, an impressive stone fort between Lough Swilly and the River Foyle. The most famous name from early Christian Donegal was St. Colmille, who founded the monastery of Iona in Scotland. See *Columba, Saint*.

The Anglo-Normans never gained control of Donegal. In 1585, the British government organized the area into a county based on the town of Donegal. Red Hugh O'Donnell and Hugh O'Neill united to fight the British at the Battle of Kinsale in 1601. Their surrender in 1603 was followed by the "Flight of the Earls" from Ireland (see *Ireland, History of*).

**Donetsk** (pop. 1,064,000) is the largest city in the Donets River Basin. It lies in eastern Ukraine. For the location of the city, see *Ukraine* (map).

Donetsk is in the centre of the rich Donets coal fields. The coal is used in the huge iron and steel mills that make Donetsk an important industrial city. Machinery and food products are also produced there. The city was founded in the 1870's under the name Yuzovka. After the Russian Revolution, its name was changed to Stalin. In 1935, it became Stalino. The name was changed to Do-

netsk in 1961 as part of Soviet Premier Nikita Khrushchev's drive to downgrade Joseph Stalin.

**Donizetti, Gaetano** (1797-1848) was an Italian opera composer. During his lifetime, he ranked second only to Gioacchino Rossini among Italian opera composers of his day. Donizetti wrote about 65 operas and operettas, and became famous for his ability to compose an opera in an astonishingly short time. He established his reputation with *Anna Bolena* (1830).

Perhaps Donizetti's finest work is the comic *Don Pasquale* (1843). Of his tragic operas, *Lucia di Lammermoor* (1835), with its famous sextet and "mad scene," is probably the most popular. Several of his other works are also often produced. They include *L'Elisir d'amore* (1832), *The Daughter of the Regiment* (1840), and *La Favorita* (1840). Donizetti was born in Bergamo.

**Donjon.** See *Castle*.

**Donkey** is the name of the domesticated ass. The wild ass of northern and northeastern Africa is the ancestor of the donkey. This wild ass looks like a zebra with no stripes, except occasionally on the legs. It stands about 1.2 metres high at the shoulders. Its coat of hair is grey, with a darker line along its back. Other characteristics of the species are long ears, small feet, and long hair at the end of the tail. Selective breeding has resulted in donkeys that vary in size, colour, and the length of their coat of hair.

The domesticated donkey is most common in southern Asia, southern Europe, and northern Africa. British settlers introduced donkeys to Australia to carry goods. Wild donkeys are now abundant in northern Australia. There are several species of the donkey. A female donkey is called a *jenny* or a *jennet*. Female donkeys give good milk. If a *jack* (male donkey) is mated with a *mare* (female horse), the animal that is born is a *mule* (see *Mule*). A cross between a female donkey and a *stallion* (male horse) is called a *hinny*. Other kinds of wild asses live on the plains of Asia. They include the *kiang*, *kulan*, and *onager* (see *Onager*). All wild asses are rare and face possible extinction.

**Scientific classification.** The donkey is in the horse family, Equidae. The domesticated donkey and the African wild ass are *Equus asinus*.



The donkey has long been a beast of burden in many countries, and it is known for its gentleness and strength.



**Donne, John** (1572-1631), was one of the greatest English poets and preachers of the 1600's. Donne was scholarly and had a keen, logical mind, but he was also deeply emotional. These qualities are evident in his poems and sermons. During his own time, Donne influenced several other poets. Donne and these poets were called the *metaphysical poets* (see **Metaphysical poets**).

**His life.** Donne was born in London. A descendant of Saint Thomas More, he was raised as a Roman Catholic. However, sometime during the 1590's, Donne became an Anglican. About 1597, he became secretary to Sir Thomas Egerton, a distinguished government official. In 1601, Donne secretly married Egerton's 16-year-old niece, Ann More. More's father was outraged at the marriage and had Donne dismissed from his position and finally imprisoned.

For the next 14 years, Donne struggled to support himself and his growing family, often living on the generosity of patrons. In 1615, at the urging of King James I, Donne became an Anglican priest. Donne also received a Doctor of Divinity degree from Cambridge. He quickly became famous for his sermons and often preached at the royal court. In 1621, Donne became dean of St. Paul's Cathedral, holding this position until his death.

**His poetry.** Donne wrote poetry on a variety of subjects and used many different *genres* (poetic types). His early *Satires* and *Elegies* follow classical models but they also have a distinctly modern flavour. In *Songs and Sonnets*, his best-known group of poems, Donne wrote both tenderly and cynically of love. His major love poems include "The Canonization" and "The Extasie."

Later, Donne turned to writing religious poetry. He produced a superb series of *Holy Sonnets*, including "Death be not proud" and "Batter my heart, three person'd God." Donne also wrote a moving meditative poem called "Good Friday, 1613. Riding Westward" and three magnificent hymns. He wrote nearly 200 poems, but only a few were published during his lifetime. The others circulated in manuscript copies and were not published until 1633. Donne's poetry was somewhat ignored during the 1700's and 1800's, but in the early 1900's, interest in his poetry revived. Modern poets, including T. S. Eliot, have praised and imitated his works.

Donne's language is dramatic, witty, and sometimes shocking. He used a variety of imagery and based his rhythms on everyday speech. At times, the complexity of his thought makes his meaning difficult to understand, but his poems always unfold in a logical way. He had a genius for creating extended poetic metaphors called *conceits*. In the metaphysical conceit, the poet developed a lengthy, complex image to express precisely his view of a person, object, or feeling. Donne's lyric, "A Valediction: Forbidding Mourning," contains his most famous conceit. Donne compares the souls of separated lovers to the legs of a compass:

If they be two, they are two so  
As stiffe twin compasses are two,  
Thy soule the fixt foot, makes no show  
To move, but doth, if th' other do.

See also **English literature** (Metaphysical and Cavalier poets).

**Donnelly, Ignatius** (1831-1901), was an American politician, reformer, and author who helped form the

Populist Party. He served in the U.S. House of Representatives from 1863 to 1869 as a Republican congressman from Minnesota, then later quit the party.

Donnelly wrote part of the Populist Party platform in 1892 (see **Populism**). This platform called for a federal income tax, *nationalization* (government ownership) of the railways, an eight-hour working day, and unlimited coinage of silver.

Donnelly was born in Philadelphia, and moved to Minnesota in 1857. He wrote several books, including one on his own theory of the earth's collision with a comet and one on Francis Bacon's supposed writing of Shakespeare's plays.

**Donoghue, Steve** (1884-1945), was one of the United Kingdom's most successful and popular jockeys. He was champion jockey 10 times, and he rode more than 2,000 winners. He won 14 Classics, including the Derby 6 times, in 1915, 1917, 1921, 1922, 1923, and 1925. Donoghue was born at Warrington, in Cheshire. He rode his first winner in 1904, in France. He rode his first winner in England in 1909. He retired in 1937.

**Doodlebug.** See **Ant lion**.

**Dooley, Thomas Anthony, III** (1927-1961), an American doctor, became famous in the 1950's as the *jungle doctor of Laos*. As a medical officer in the U.S. Naval Reserve, he served on a ship that carried Southeast Asian refugees. He also organized refugee camps in Vietnam. He left the Navy in 1956 to start a private, mobile medical unit in Laos. In 1957, Dooley helped found MEDICO (Medical International Cooperation Organization). He helped finance MEDICO with funds from lecture tours and books he wrote.

Dooley's three books—*Deliver Us from Evil* (1956), *The Edge of Tomorrow* (1958), and *The Night They Burned the Mountain* (1960)—describe his experiences in Southeast Asia.

**Doolittle, Hilda** (1886-1961), an American poet, was a leader of the imagism movement in poetry during the early 1900's. Doolittle's style reflects imagism's emphasis on the clear, precise, and objective treatment of images, scenes, and events. She was strongly influenced by classical literature, especially Greek verse. Many of her poems deal with Greek mythology. She also wrote three long poems about her experiences in London during World War II (1939-1945). The poems are *The Walls Do Not Fall* (1944), *Tribute to the Angels* (1945), and *The Flowering of the Rod* (1946).

Doolittle was born in Bethlehem, Pennsylvania. She moved to Europe in 1911 and lived primarily in London and in Switzerland until her death.

**Doolittle, James Harold** (1896-1993), a noted American pilot, led the first bombing raid on Tokyo in World War II. He led 16 B-25 twin-engine bombers, normally land-based planes, from the deck of the aircraft carrier U.S.S. *Hornet* in the surprise attack on Tokyo on April 18, 1942.

A lieutenant colonel when he led his raid, Doolittle rose to lieutenant general during World War II. He commanded the 12th Air Force in the North African invasion in 1942, and later the 15th Air Force in the Mediterranean area. In 1944 and 1945, he was commander of the 8th Air Force, which bombed western Europe. He also commanded the 8th Air Force on Okinawa after Germany surrendered.



Doolittle was born in Alameda, California, and graduated from the University of California. He was an Army aviator during World War I. Doolittle left the Army in 1930 to work for the Shell Petroleum Corporation. He returned to military duty in 1940.

Doolittle was chairman of the National Advisory Committee for Aeronautics from 1956 to 1958. He was director of the Space Technology Laboratories, an aerospace firm, from 1959 to 1962.

See also **Aeroplane** (table: Speed records); **World War II** (The tide turns).

**Doom palm.** See **Doom palm**.

**Doomsday Book.** See **Domesday Book**.

**Doon**, a river in Strathclyde Region, Scotland, was made famous by the poetry of Robert Burns. It rises in the Kells Range at Loch Doon and flows northwest to empty into the Firth of Clyde near Ayr.

See also **Cumnock and Doon Valley**.

**Doppler effect** is the change in frequency of sound, light, or radio waves caused by the relative motion of the source of the waves and their observer. For example, the *pitch* (frequency) of a train whistle seems higher when the train approaches and lower after it passes and begins to move away. The actual pitch of the whistle remains constant.

Astronomers study the speed of a star by measuring the apparent change in the frequency of its light waves caused by motion. Christian Doppler, an Austrian physicist, described the effect in 1842.

See also **Sound** (The speed of sound); **Log; Radar** (Continuous-wave radar); **Relativity** (General relativity theory); **Red shift**.

**DORA**, Defence of the Realm Acts, were passed in 1914 and 1915 to give the United Kingdom (UK) government special powers during World War I (1914-1918). The acts curtailed the rights and liberties of the people and aroused severe criticism. They amounted to a kind of statutory martial law. They ceased to have effect in 1921.

Various Emergency Powers Acts, most of which were passed by Parliament in 1939, gave the UK government similar powers during World War II (1939-1945).

**Dorado.** See **Dolphin** (fish).

**Dorchester, Baron.** See **Carleton, Sir Guy**.

**Doré, Gustave** (1832-1883), a French painter and sculptor, illustrated a large number of literary masterpieces. These include the Bible, the works of Rabelais and Balzac, Dante's *Divine Comedy*, LaFontaine's *Fables*, Tennyson's *Idylls of the King*, Cervantes' *Don Quixote*, Coleridge's "The Rime of the Ancient Mariner," and Poe's "The Raven." His style is dramatic and imaginative, but sometimes repetitious.

Doré was born Paul Gustave Doré in Strasbourg, Alsace-Lorraine. As a boy, he showed a remarkable talent for drawing. His work was in great demand while he was still quite young. His fame outside of France rests chiefly on his illustrations.

See also **City** (picture: The Industrial Revolution).

**Dore metal.** See **Assaying** (Dry process).

**Dorians** were a group of ancient Greeks. They lived in the northwestern part of the Greek mainland before 1200 B.C. According to Greek tradition, the Dorians overran most of the *Peloponnesus* (the southern peninsula of Greece) toward the end of the 1100's. The best-known Greeks of Dorian descent were the Spartans. In



Detail of *Satan's Flight Through Chaos*; illustration from *Masterpieces from the Works of Gustave Doré*.

A Doré engraving illustrates an edition of *Paradise Lost* by John Milton. Doré's engravings are among his best works.

addition to Sparta, Dorian cities included Argos, Corinth, Megara, and Rhodes. Dorians also settled in Crete, Sicily, southern Italy, the Sporades Islands, and southwestern Asia Minor (present-day Turkey). Some scholars have questioned whether the Dorians actually existed.

See also **Achaean**; **Aeolians**; **Corinth**; **Greece, Ancient** (History); **Ionians**; **Mycenae**; **Sparta**.

**Dormancy.** See **Germination**.

**Dormouse** is a tiny mammal that looks like a small squirrel. Dormice are well known for their sleepy ways. When cold weather arrives, they stock a nest with food and *hibernate* (sleep through the winter).

The dormouse has fine, silky fur, a pointed nose, and big black eyes. Its body is about 8 centimetres long, and so is its tail. Dormice are rodents, and are related to mice and rats. They live in trees and bushes in parts of Africa, Asia, and Europe. Dormice hunt for food at night, and eat berries, grains, and nuts.

**Scientific classification.** Dormice belong to the dormouse family, Gliridae. There are several genera.



The tiny dormouse has a pointed nose and a long tail.





The Dorset coast has some unusual features. Chesil Bank is a huge bank of pebbles built up by the sea. It runs from Portland for 29 kilometres along the coast.

**Dörpfeld, Wilhelm.** See Troy (The archaeological Troy).

**Dorset**, a county in southern England, was once a shire of the Kingdom of Wessex. The writer Thomas Hardy made Dorset's countryside and traditions familiar to people in many parts of the world.

### People and government

**Local customs.** Dorset's many local customs range from country dances to street fairs. The *Abbotsbury Garland Day* on May 13 each year and the *Midsummer Filly Loo* at Ashmore are examples of customs dating back more than a thousand years.

**Recreation.** Dorset has all the sports associated with a coastal county: swimming, sailing, sea fishing, and water-skiing. The countryside and coast provide a beautiful setting for walking, riding, and touring. Weymouth has many seaside resort facilities, and Poole has greyhound and speedway racing. Bournemouth has a major indoor sports centre and athletics track, as well as several golf courses. Many sporting events take place at Bournemouth, including tennis, golf, and swimming championships. The town has a soccer team that plays in the Football League.

**Local government.** Dorset is divided into eight local government districts. They are: *Bournemouth, Christchurch, East Dorset, North Dorset, Poole, Purbeck, West Dorset, and Weymouth and Portland*. The county is policed by the Dorset Police, who have their headquarters

at Winfrith, near Dorchester. The crown court sits at Bournemouth, Dorchester, and Poole.

### Economy

**Agriculture and mining.** Dorset's traditional industry is agriculture. Much land is devoted to pasture, but farmers also grow cereals—mainly barley. Much of the farmers' income comes from milk. Fish farming and the growing of watercress are common.

Quarries on the Isle of Purbeck produce building stone and marble. The building stone from Purbeck and from Portland has been used in many famous buildings. Clay is also mined in Dorset.

In the late 1950's, oil was discovered in Dorset. The Wytch oilfield, where production began in 1979, is the largest onshore oilfield in western Europe. Other oil fields are at Kimmeridge, Stoborough, and Wareham.

**Manufacturing and service industries.** Dorset became a centre for financial and insurance services, fol-

### Facts in brief about Dorset

**Administrative centre:** Dorchester.  
**Largest towns:** Bournemouth, Poole, Weymouth, Christchurch, Dorchester.

**Area:** 2,655 square kilometres.

**Population:** 1991 census—645,200.

**Chief products:** Beef, building materials, dairy products, engineering goods, oil, pottery.



lowing office relocations to the Bournemouth-Poole area in the 1980's. Poole is the county's largest centre of industry. Its earthenware factories produce drain pipes, porcelain, pottery, and tiles. Other industries include electronics, food processing, shipbuilding and marine engineering, and the production of caravans and chemicals. Weymouth has engineering works. Winfrith has an atomic energy research establishment.

Sherborne has a silk industry dating from the 1700's. During World War II (1939-1945), it produced parachutes. Today, the town produces fabrics from glass fibre. Dorchester's industries include brewing, printing, and the manufacture of farm machinery and leather goods. Blandford has an industrial estate, making a range of goods including hospital equipment.

**Tourism.** Dorset's economy depends greatly on tourism, especially in the coastal areas. Bournemouth is one of the United Kingdom's leading resorts and has a wide variety of entertainment. Weymouth is another resort with good facilities. Inland, many farmhouses offer overnight and holiday accommodation.

**Transportation and communication.** A main road from London to Devon and Cornwall, the A303, crosses northern Dorset. Bournemouth is linked to London by the A31 and M3. Rail services from London serve Christchurch, Bournemouth, Poole, Wareham, Dorchester, and Weymouth. The main line to Exeter passes through Gillingham, to the northwest of Shaftesbury. Weymouth is a port for traffic to the Channel Islands. Poole has an outstanding natural harbour and is a busy port. Bournemouth has regular air services to other United Kingdom airports and to the Channel Islands.

Bournemouth and Weymouth have their own daily newspapers. An independent radio station broadcasts from Bournemouth.

## Land

**Location and size.** Dorset is on the south coast of England. Its coastline on the English Channel is about 137 kilometres long. Dorset extends up to 58 kilometres inland, bordering Wiltshire to the northeast, Hampshire to the east, and Devon and Somerset to the west.

**Land features.** The countryside is extremely varied, with uplands and valleys, broad fertile clay vales, and open heathlands. Central Dorset consists of a great arc of chalk downland, which is a continuation of the Salisbury Plain.

The chalk downlands swing southwest through Cranborne Chase to Abbotsbury, before swinging eastward through the Isle of Purbeck to emerge at Ballard Down. The other branch continues westward into Somerset. The downlands are broken into wide ridges cut by long, fertile valleys. The highest point on the downlands is Pilsdon Pen. It is 277 metres above sea level.

In the east, the broad, gravelly, and sandy Dorset heathlands are interspersed with beds of clay. A series of vales and lowlands lies on the northern side of the downlands. To the south of Poole Harbour, the coast contains a series of bays and capes. *Erosion* (natural wearing away of rock) has caused the formation of numerous bays, inlets, arches, and caverns along the coast between St. Aldhelm's Head and Weymouth. The limestone Isle of Portland divides the Dorset coast in half. West of Portland is the Chesil Bank, which sweeps in a



Dorset lies on the south coast of England. It has a varied landscape, with uplands, valleys, vales, and heathlands.

gentle curve for 29 kilometres. For part of its length, it blocks off a lagoon, the Fleet.

**Rivers.** The Stour is the most important river. The Stour and its tributaries, the Cale and the Lydden, flow through the Vale of Blackmoor before they join and cut through the chalk. At Wimborne, the Stour is joined by the Allen before meeting the River Avon. The Avon forms part of Dorset's eastern boundary, and then empties into the English Channel at Christchurch. The River Frome rises to the northwest of Dorchester, and meanders gently towards Wareham, before emptying into Poole Harbour.

**Climate.** Dorset is a sunny county. Its average annual rainfall is about 890 millimetres. The coast is drier. The mean summer temperature ranges between 13° C and 15° C. The mean winter temperature varies from 5° C in the north to 9° C in the south. The south is slightly cooler in summer than the north, but it is warmer in the winter.

## History

Prehistoric remains show that men have lived in the region that is now Dorset since the Stone Age. It is named after the Durotriges, a tribe that lived in the area. The Romans built many settlements in this part of the world. Many of their roads still exist. Cerne Abbey was established before the Normans arrived. Many castles were built after the Norman conquest, including those at Corfe, Sherborne, and Wareham.

At Tolpuddle, George Loveless gathered together five fellow labourers to form the first *Friendly Society of Agricultural Labourers*. In 1834, these six men were found guilty of administering illegal oaths and were deported to Australia. They became famous as the *Tolpuddle Martyrs*. Other people associated with Dorset include the poet George Crabbe, who was rector of Frome, St. Quintin, and Evershot. In the early 1800's, Mary Anning, the geologist, discovered the fossil remains of an ichthyosaur on the Dorset coast. The novelist Jane Austen and the poet William Wordsworth lived near Lyme Regis. Thomas Hardy described Dorset in many novels.



Sir Christopher Wren, the architect of St. Paul's Cathedral, London, was a member of parliament for Weymouth. Three of Horatio Nelson's captains, Thomas Masterman Hardy, Charles Buller, and Henry Digby, were Dorset men. Other people closely associated with Dorset include the writers Henry Fielding, Fanny Burney, Charles Kingsley, and T. E. Lawrence.

**Related articles in *World Book* include:**

Austen, Jane	Hardy, Thomas
Bournemouth	Kingsley, Charles
Burney, Fanny	Lawrence, T. E.
Crabbe, George	Poole
Fielding, Henry	Wren, Sir Christopher

**Dosimeter.** See *Electroscope* (with picture).

**Dos Passos, John** (1896-1970), was an American novelist whose work is dominated by social and political themes. His experiments in fiction earned him distinction as a novelist in the 1920's and 1930's.

Dos Passos first achieved fame with his World War I novels, *One Man's Initiation* (1917) and *Three Soldiers* (1921). *Three Soldiers* protests the impact of war on civilization and art. *Manhattan Transfer* (1925) reveals Dos Passos' disillusioned response to postwar urban America. This novel led to his most famous work, the *U.S.A.* trilogy, which pessimistically surveys the disintegration of U.S. culture that Dos Passos believed took place during the first three decades of the 1900's. The *U.S.A.* trilogy consists of *The 42nd Parallel* (1930), *1919* (1932), and *The Big Money* (1936).

*U.S.A.* brings together many characters in a wide variety of episodes. Dos Passos featured a technique called the Newsreel, which used newspaper headlines, words from popular songs, and advertisements to surround the action and characters. Another technique, called The Camera's Eye, gives the author's view of his subject. Dos Passos regarded his style as providing a social and historical background in which individual actions reflected larger patterns he saw in United States society.

John Rodrigo Dos Passos was born in Chicago and attended Harvard University. He was a political liberal in his early years, but moved sharply toward conservatism by the 1940's. His *District of Columbia* trilogy—*Adventures of a Young Man* (1939), *Number One* (1943), and *The Grand Design* (1949)—reveals his conservative attitudes. Dos Passos also wrote *Mr. Wilson's War* (1962), a history of World War I.

**Dostoevsky, Fyodor** (1821-1881), was one of the greatest writers in Russian literature. Dostoevsky's finest works are novels of ideas, embodied in great characters. His intensely individual and complex characters are usually caught up in very dramatic plots. The underlying theme in his books is the struggle between good and evil for dominance of the human soul. Dostoevsky attempts to resolve this struggle by leading his characters to salvation through purifying suffering.

Fyodor Mikhailovich Dostoevsky was born in

Moscow. He received a military engineering education in St. Petersburg, but decided to follow a literary career. Dostoevsky's first novel was *Poor Folk* (1846), a psychological study written in letter form. His next book, *The Double* (1846), is the complex story of an unpopular civil servant who goes mad and sees his own double. During the late 1840's, Dostoevsky wrote many stories about the poor and the downtrodden as well as strange and abnormal residents of St. Petersburg.

In 1847, Dostoevsky joined the Petrashevsky circle, a group of socialists who met to read and discuss political and economic books banned by the government. In 1849, police arrested the members of the circle. Dostoevsky and several others were condemned to death by a firing squad. By order of the czar, they were pardoned moments before they were to die. Dostoevsky was then sentenced to four years of hard labour in Siberia. Then he had to serve four years as a common soldier.

After returning to St. Petersburg in 1859, Dostoevsky wrote *Notes from the House of the Dead* (1860-1862). It is a fictionalized version of his prison experiences and one of the great prison works in Western literature. Years of poverty followed for Dostoevsky. He was plagued by financial difficulties because of poor money management and gambling losses.

Dostoevsky achieved success with *Notes from Underground* (1864), a psychological study of a spiritual and intellectual misfit. His greatest success came with four novels that rank among the masterpieces of world literature. *Crime and Punishment* (1866) concerns a student who murders because he imagines himself to be superior to most people, but who cannot face the enormity of his crime. In *The Idiot* (1868-1869), Dostoevsky tried to portray a truly good Christian person. *The Possessed* (1871-1872), also published as *The Devils*, is a prophetic portrait of Russian revolutionaries. Dostoevsky's greatest novel is probably *The Brothers Karamazov* (1879-1880). It centres on the murder of the evil Fyodor Karamazov and the effect of this crime on each of his four sons.

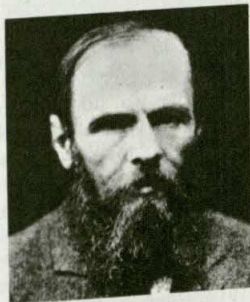
His later works show Dostoevsky to be a pioneer in psychological analysis and an important and original religious thinker. As an interpreter of the human condition, he anticipated many of the ideas of the philosophical movement called *existentialism*.

See also **Russian literature** (The 1860's and 1870's).

**Douala** (pop. 1,029,731) is the largest city and chief seaport of Cameroon. It lies along the Wouri River, about 25 kilometres from where the river flows into the Gulf of Guinea, an arm of the Atlantic Ocean (see **Cameroon** [map]).

Busy docks line parts of Douala's waterfront. A bridge that is 1,800 metres long spans the Wouri River in Douala. The city has open squares, a cathedral, and a museum. Shipping and related businesses are the chief economic activities. Other activities in the Douala area include banking; cacao processing; and the production of beer, cement, fertilizer, leather, matches, shoes, tobacco goods, and textiles.

The city is named after the Douala people, who have lived in the area for hundreds of years. The Douala established a number of villages there. The Germans, who ruled the area from 1884 to 1916, built the city on the site of the villages. Douala was enlarged by the French, who governed it from 1919 to 1960.



Fyodor Dostoevsky



**Douay Bible.** See Bible (Early English translations).

**Double knit.** See Textile (Knitted fabrics).

**Double star.** See Binary star.

**Doubleday, Abner** (1819-1893), was a United States Army officer who was once considered the inventor of baseball. To settle a dispute over the origin of the game, Albert G. Spalding, a sporting-goods manufacturer and former baseball player, suggested the appointment of a commission to study the matter. The commission's report, published in 1908, credited Doubleday with inventing the game in Cooperstown, New York, in 1839. In honour of Doubleday, Cooperstown residents established the National Baseball Hall of Fame and Museum in the town. The Hall of Fame operates under the jurisdiction of professional baseball. Most historians today claim that Doubleday had little, if anything, to do with baseball. They believe the sport probably developed from an English game called *rounders*. See **Baseball** (History [The Abner Doubleday theory]).

Doubleday was born in Ballston Spa, New York. He graduated from the United States Military Academy in 1842, and he served in the Mexican War (1846-1848). Doubleday became a major general in the Union Army during the Civil War (1861-1865). He commanded the troops at Fort Sumter that fired the first shots by the North in the Civil War. Doubleday also fought heroically at the Battle of Gettysburg.

**Doublet**, in clothing, see **Clothing** (The Renaissance); in jewellery, see **Gem** (Imitation and artificial gems).

**Doubloon** is a Spanish and Spanish-American gold coin that was widely used in America until the 1800's. The name comes from the Latin *duplus*, meaning *dou-*



**A Spanish doubloon** has a profile of King Charles IV of Spain on one side. This coin was minted in Lima, Peru, in 1801.

*ble*. It was also called *doblón de a ocho* meaning *doubloon of eight*, because it was worth eight gold escudos. It weighed about 27 grams.

**Doubting Thomas.** See Thomas, Saint.

**Douc langur.** See Monkey (picture).

**Doughnut** is a round, fried cake with a hole in the centre. Dutch settlers brought the fried cake (*olykoeck*) to colonial America. A legend suggests that Captain Hanson Gregory, an American sea captain, invented the doughnut hole in 1847. According to this legend, he cut holes in the dough before frying to make the cakes more digestible.

**Doughty, Charles Montagu** (1843-1926), a British author, travelled in western and southern Europe, and in Asia, writing on geology and collecting inscriptions. He wrote *Travels in Arabia Deserta* (1888), a vivid picture of

Arabia during the 1870's. Doughty collected the information on which this work is based while living and travelling among the Arabs, dressed as an Arab Christian and speaking Arabic. His journey lasted almost two years, and he returned to Britain, exhausted, in 1878.

Doughty himself preferred his poetry to his prose. His epic works include *The Dawn in Britain* (1906), and *Man-soul* (1920, revised in 1923). He was born in Suffolk, and studied at Cambridge University.

**Douglas** (pop. 20,368) is the capital of the Isle of Man in Britain. It is a popular holiday resort overlooking Douglas Bay on the east coast of the island. The beach has good sands and facilities for swimming. Places of interest include the Manx National Museum, which also houses the Isle of Man's National Library, and Nobles Park, a camping site and recreation area. The town is the scene of two annual motorcycle race meetings, the Tourist Trophy, held in June, and the Manx Grand Prix, held in September. See also **Man**, Isle of.

**Douglas, Donald Wills** (1892-1981), an American aircraft manufacturer, organized the Douglas Company in 1921. It became the Douglas Aircraft Company, Inc., in 1928 and the McDonnell Douglas Corporation in 1967. He designed the army planes that made the first flight around the world in 1924. His firm has made widely used commercial airliners. Douglas was born in Brooklyn, New York. See also **Aviation** (History of the aviation industry).

**Douglas, Sir James** (1803-1877), served as the first governor of the colony of British Columbia, in what is now Canada. Douglas held the office from 1858 to 1864.

Douglas was born in Demerara, British Guiana (now Guyana), and was educated in Great Britain. In 1820, he went to Quebec as an employee of the North West Company, a British fur-trading firm. The Hudson's Bay Company, a rival organization, took over the North West Company in 1821.

From 1839 to 1858, Douglas served as chief officer in the Columbia territory for the Hudson's Bay Company. In 1843, he founded Fort Victoria (now Victoria) as headquarters for the company. The fort stood on Vancouver Island, which today forms part of British Columbia. Vancouver Island became a British colony in 1849, and Douglas served as governor from 1851 to 1863. He was knighted in 1863.

**Douglas, Lloyd Cassel** (1877-1951), an American Protestant minister, wrote the best-selling novels *Magnificent Obsession* (1929), *The Robe* (1942), and *The Big Fisherman* (1948). He also wrote *Forgive Us Our Trespases* (1932), *Green Light* (1935), and *Invitation to Live* (1940). *A Time to Remember* (1951) is his autobiography. As a novelist, Douglas was mainly interested in inspiring religious teaching, but, to his surprise, his books won great popularity.

Douglas was born in Columbia City, Indiana. He graduated from Wittenberg College. He began to preach in Indiana, and then became a pastor in Washington, D.C. Later, he directed religious work at the University of Illinois, and served as a pastor in Ann Arbor, Michigan; Akron, Ohio; and Los Angeles, California.

**Douglas, Norman** (1868-1952), a British writer, is best known for his witty and satirical novel *South Wind* (1917). The book is set on an imaginary island called Nephenthe, based on the island of Capri. The word *nepen-*



the means a drug capable of banishing sorrow and fear. The central theme is the nature of truth. Thomas Heard, an Anglican bishop, receives an education in the complexity of truth and a doctrine of individualism. Douglas' books about the Mediterranean region, include *Siren Land* (1911) and *Old Calabria* (1915). He wrote two other novels, *They Went* (1921) and *In the Beginning* (1928). George Norman Douglas was born near Aberdeen, Scotland.

**Douglas, Thomas.** See Selkirk, Earl of.

**Douglas fir** is one of the largest and most valuable timber trees in the world. This *conifer* (cone-bearing) tree is the source of more timber than any other single tree in North America. It is common in the Western United States and Canada, both in the Pacific Coast region and the Rocky Mountains. It also grows in eastern Asia. This tree grows from 55 to 75 metres tall and 90 to 120 centimetres thick through the trunk. Its flat needles are about 2 centimetres long. Its egg-shaped cones have odd, three-pointed *bracts* (leaflike structures). The Douglas fir is the state tree of Oregon in the United States.

**Scientific classification.** The Douglas fir is in the pine family, Pinaceae. It is *Pseudotsuga menziesii*.

See also *Conifer*; *Pine*; *Spruce*; *Tree* (picture: Familiar broadleaf and needleleaf trees).

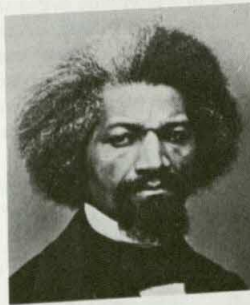
**Douglas-Home, Alexander Frederick.** See Home, Lord.

**Douglas of Kirtleside, Lord** (1893-1969), William Sholto Douglas, one of Britain's air commanders during World War II, was chairman of British European Airways (now British Airways) from 1949 until 1964. Douglas was born in Oxford. In World War I, he commanded a fighter squadron. During World War II, he held successively the posts of Assistant chief of air staff, chief of fighter command, chief of Middle East command, and chief of coastal command.

**Douglass, Frederick** (1818?-1895), was the leading spokesman of American blacks in the 1800's. Born a slave, Douglass became a noted reformer, author, and orator. He devoted his life to the abolition of slavery and the fight for black rights.

Frederick Augustus Washington Bailey was born in Tuckahoe, Maryland, near Easton. At the age of 8, he was sent to Baltimore to work for one of his master's relatives. There, helped by the wife of his new master, he began to educate himself. He later worked in a shipyard, where he *caulked* ships, making them watertight.

In 1838, the young man fled from his master and went to New Bedford, Massachusetts. To avoid capture, he dropped his two middle names and changed his last name to Douglass. He got a job as a caulker, but the other men refused to work with him because he was black. Douglass then held a number of unskilled jobs, among them collecting rubbish and digging cellars.



Frederick Douglass



The Douglas fir towers above most other trees in the evergreen forests of the western United States and Canada. It provides more timber than any other kind of North American tree.

In 1841, at a meeting of the Massachusetts Antislavery Society, Douglass told what freedom meant to him. The society was so impressed with his speech that it hired him to lecture about his experiences as a slave. In the early 1840's, he protested against segregated seating on trains by sitting in cars reserved for whites. He had to be dragged from the white cars. Douglass also protested against religious discrimination. He walked out of a church that kept blacks from taking part in a service until the whites had finished participating.

In 1845, Douglass published his autobiography, *Narrative of the Life of Frederick Douglass*. He feared that his identity as a runaway slave would be revealed when the book was published, so he went to England. There, Douglass continued to speak against slavery. He also found friends who raised money to buy his freedom.

Douglass returned to the United States in 1847 and founded an antislavery newspaper, the *North Star*, in Rochester, New York. In the 1850's, Douglass charged that employers hired white immigrants ahead of black Americans. He once declared: "Every hour sees the black man elbowed out of employment by some newly arrived immigrant whose hunger and whose colour are thought to give him a better title to the place." He accused even some abolitionist business executives of job discrimination against blacks.

Douglass also led a successful attack against segregated schools in Rochester. His home was a station on the underground railway, a widespread system which helped runaway slaves reach freedom (see *Underground railway*).

During the Civil War (1861-1865), Douglass helped recruit blacks for the Union Army. He discussed the problems of slavery with President Abraham Lincoln several times. Douglass served as Recorder of Deeds in the District of Columbia from 1881 to 1886 and as U.S. minister to Haiti from 1889 to 1891. He wrote two expanded versions of his autobiography—*My Bondage and My Freedom* (1855) and *Life and Times of Frederick Douglass* (1881).



**Doukhobors**, also spelled *Dukhobors*, belong to a Christian sect in western Canada. *Doukhobors* is a Russian word meaning *spirit wrestlers*. They believe the "voice within" each person is his or her guide. Therefore, they see no need for churches or governments. Doukhobors are pacifists.

Peasants founded the sect in Russia in the mid-1700's. The Doukhobors adopted many of the ideas of the Russian author Leo Tolstoy in the late 1800's, under the leadership of Peter Verigin. In 1899, Tolstoy and English and American Quakers helped more than 7,000 Doukhobors emigrate to western Canada. There they established communal farms. The group still survives, but its communal life has largely died out. A small group of Doukhobors called the *Sons of Freedom* wishes to restore the communal communities in Canada or in any country that would welcome them.

**Doulton, Sir Henry** (1820-1897), was a British pottery maker who produced articles of both artistic and commercial value. His factory at Burslem, in Staffordshire, made lovely earthenware and bone china. Doulton foresaw a demand for glazed drainpipes and built a factory to produce them. He also made the china insulators that were essential to the growing telegraph system. Doulton was born at Lambeth, in London, and at 15 joined the family business. See also **Porcelain; Pottery**.

**Doom palm**, also spelled *doom palm*, grows in Arabia, upper Egypt, and central Africa. Each branch of the doom palm ends in a tuft of deeply lobed, fan-shaped leaves. The tree bears an irregularly oval fruit about the size of an apple. The fruit has a red outer skin and a thick, spongy, and rather sweet inner substance that tastes like gingerbread. The palm has often been called the *gingerbread tree*. Large quantities of these fruits have been found in the tombs of the Egyptian pharaohs. The seeds are a source of *vegetable ivory*.

**Scientific classification.** The doom palm is in the palm family, Palmae. It is *Hyphaene thebaica*.

**Dove** is a name that refers to the smaller members of the pigeon and dove family. The name *pigeon* refers to the larger members of the family. Doves live in temperate and tropical regions throughout the world.

Doves have plump bodies and small heads. They grow from 15 to 30 centimetres long and weigh from 28 to 255 grams. They fly rapidly and have low cooing voices. Doves eat fruits, grains, insects, and nuts.

**Scientific classification.** Doves belong to the pigeon and dove family, Columbidae.

See also **Mourning dove; Pigeon; Turtledove**.

**Dove, Arthur Garfield** (1880-1946), was one of the earliest abstract painters in the United States. He painted his first symbolic abstract pictures of nature in 1910, long before abstract painting was common in America. His compositions, which are usually rather small, emphasize areas of solid colour and lines and edges. Dove made constructions similar to collages in the 1920's (see **Collage**).

Dove was born in Canandaigua, New York, and gained early success as a magazine illustrator. He lived in Paris for 18 months during 1908 and 1909, and absorbed the influence of the new abstract art movements there. When he returned to New York, he began painting in a manner similar to that of the abstract expressionists of the 1940's. Dove was never a popular success. Alfred Stieglitz, a photographer and art dealer, helped support him and exhibited his work.

**Dover** (pop. 102,600) is a local government district in eastern Kent, England. It includes the important channel port of Dover, and the seaside town of Deal. Sandwich, a historic town in the north of the district, and Dover are cinque ports (see **Cinque ports**). Arable farming and sheep farming are also important. Sandwich has an industrial estate with many light industries. Products include electronic and engineering goods, furniture, pharmaceuticals, and plastics.

Dover town is the chief port for travel between Britain and France and Belgium. It provides a safe anchorage for steamers, ferries, and hovercraft serving Boulogne, Calais, Dunkerque, Ostend, and Zeebrugge. The port is run by the Dover Harbour Board, which was set up by Royal Charter in 1606. In 1987, construction began on a railway tunnel in Dover linking Britain to France. Completion was scheduled for 1993.

**Dover, Strait of**, is a narrow channel which connects the English Channel and the North Sea and separates England and France at their closest points. The strait is only about 34 kilometres wide and is very shallow, with an average depth of less than 30 metres. Chalk cliffs rise high on either side of the strait. The ports of Dover, England, and Calais, France, are opposite each other on the Strait of Dover. Great Britain and France are building a railway tunnel under the strait. Preliminary work, such



The mourning dove was named after the sad cooing sound made by the male. This North American bird is found from southeastern Alaska and southern Canada to Panama.





**Dover**, located on the English Channel, is Britain's busiest port. Its car ferry terminal handles vehicles and passengers bound for any one of five destinations on the European mainland.

as clearing the land near the tunnel, began in 1987. Construction of the tunnel is expected to be completed in 1993. Many swimmers have set records by swimming across the English Channel, usually from Calais to Dover (see English Channel).

**Dow Jones averages** are statistics that show the trend of prices of stocks and bonds in the United States. They are averages of selected stocks and bonds traded on the New York Stock Exchange. Dow Jones & Company, a financial publishing firm, computes averages for each trading hour of every business day. There are four kinds of these averages: (1) an average of the common stock prices of 30 industrial firms, (2) an average of the common stocks of 20 transportation companies, (3) an average of the common stocks of 15 utility companies, and (4) an average of the 65 stocks that make up the first three averages. Public interest is centred on these averages.

The industrial stock average is the one most often used by investors. Its advances and declines, like those

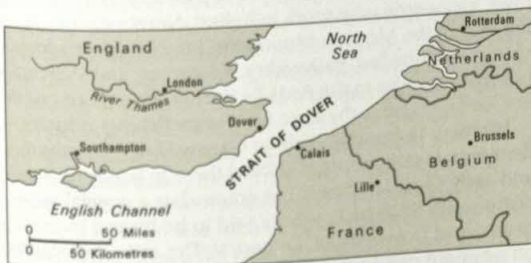
of the other averages, are given in *points*. For example, suppose the industrial average at the close of trading on one day is 879.32, and on the following day the average goes up to 882.56. Economists compare the two figures and say that the average has then risen 3.24 points.

In 1896, Dow Jones began to publish an industrial average, using the stocks of 12 companies. The average was a simple total of the prices of these stocks, divided by 12. However, some companies whose stocks were used in the average began *splitting* their stocks. That is, they issued two or more shares of stock for each existing share. The price of the stock then dropped in proportion. Suppose, for example, that a stock was selling for \$18. If the company *split it two for one* (issued two shares for each existing share), the price would drop to \$9. The investor would lose nothing, because two shares of stock would still be worth \$18. But the Dow Jones average, if the \$9 price were used, would take into account an artificial decline from \$18.

Stock averages can be distorted by other causes besides splits. To provide a correction for all these causes, Dow Jones uses a flexible divisor. After a stock split, the total of the prices of all the stocks used in the average is not divided by the number of stocks. Instead, a divisor is used that will make the average equal to what it was before the split. The first flexible divisor, introduced in 1928, was 16.67. Because of corrections through the years, the divisor for industrials was about 0.75 by the late 1980's. The divisor is changed to correct a distortion of five or more points in the average.

See also **Stocks and shares**.

**Dowding, Lord** (1882-1970), Hugh Caswall Tremeneere Dowding, led the British Fighter Command of the



The Strait of Dover lies between England and France.



Royal Air Force to victory in the Battle of Britain of World War II in 1940. He was dismissed from his leadership of Fighter Command shortly after the battle. Many thought that Dowling's dismissal was unjust. Dowling started his career in the army, but soon took an interest in flying. He joined the RAF shortly after its formation in 1918. See also **Battle of Britain**.

**Dowland, John** (1563-1626), was an English composer during the Renaissance. He was also considered one of the best lute players of his time. The lute is a stringed instrument with a pear-shaped body and is played like a guitar. Dowland composed many songs for voice accompanied by the lute. "Flow my tears" from his *Second Book of Aires* (1600) was one of the most famous pieces of its time. Dowland's beautiful songs are often on dark and melancholy subjects. He also wrote religious songs, difficult lute solos, and dances for lute and Renaissance bowed instruments called *viols*.

Dowland may have been born in London. He graduated from Oxford University and performed at the court of Elizabeth I. Dowland served various foreign rulers, notably the king of Denmark from 1598 to 1606, when he returned permanently to England. In 1612, he became court lutenist to King James I.

**Down** (pop. 57,503) is a local government district in Northern Ireland. It lies between Strangford Lough and Dundrum Bay in southeastern Ulster. The people of Down are distinguished by religion rather than by descent. The district is mainly agricultural. Barley and potatoes are the chief crops, and farmers also rear cattle. Ballynahinch is an important agricultural town, Ardglass has a herring industry, and Newcastle is a popular seaside resort. Downpatrick is the district's administrative centre.

Down is also the name of one of the six counties of Northern Ireland. Following local government reorganization in 1973, this county ceased to have any significance as an administrative unit. But it remains important geographically and culturally. See **Down, County**.

**Down, County** is one of the six counties of Northern Ireland. The county is located between the sea inlets of Belfast Lough and Carlingford Lough. It is bounded by the Irish Sea in the southeast. Strangford Lough is also located within the county boundaries. The historic county of Down has an area of 2,466 square kilometres. In the west, it extends to the southeast corner of Lough Neagh, Ireland's largest lake.

When Northern Ireland's local government was restructured in 1973, the county of Down disappeared as an administrative unit. Its area was absorbed into the new districts of Ards, Banbridge, Castlereagh, Down, Lisburn, Newry and Mourne, and North Down.

Before these changes, County Down had a population of 311,876, according to the 1971 census. The government no longer publishes figures for the population that lives within the old county borders.

Much of the county of Down is a low flat area. A feature of the landscape is the clusters of small egg-shaped hills called *drumlins*. In the centre of the county, the mountains of Slieve Croob rise to a height of 54 metres above sea level. To the south is the magnificent scenic area of the Mountains of Mourne. Slieve Donard, the highest peak in Northern Ireland, reaches 850 metres.

North Down, with its administrative centre at Bangor,



**County Down** faces the Irish Sea. Its most westerly point extends to the southeast corner of Lough Neagh.

extends from the head of Strangford Lough to the shores of Belfast Lough. The Ards Peninsula is the long sleeve of land between Strangford Lough and the Irish Sea. The lowlying plain around Downpatrick on the other side of Strangford Lough is known as *Lecale*.

In the Mourne Mountains are the dams of the Silent Valley and Spelga, which supply much of Northern Ireland with water. Tollymore Park, on the slopes of the Mournes, has about 500 hectares of forest.

Strangford Lough is dotted with hundreds of small islands, on which seabirds nest in great numbers. There is a swift tidal *race* (current) at the Lough's narrow entrance. A car ferry connects the villages of Portaferry and Strangford across the narrows.

Down has a mild climate. The county enjoys more hours of sunshine a year than any other region of Northern Ireland. The average temperature in January is 5° C and in July is 15° C. Rainfall varies from 1,750 millimetres a year in the Mournes to 825 millimetres on the coast.

**Economy.** Agriculture is an important part of the economy of Down. In the northern part of the county, farmers specialize in dairy produce and in market gardening. In the lowlying parts to the east, and the Ards Peninsula, farmers grow wheat, barley, and oats. Elsewhere the fertile soils are perfect for potatoes. The rearing of sheep, cattle, and pigs is also important. In the upland areas, the soils are generally poor.

**Chief towns.** The former county town of Downpatrick is now the administrative centre of the district of Down. Other large towns are Newry, Newtownards, and Bangor. Smaller towns include Banbridge, Ballynahinch, Dromore, Castlewellan, Crossgar, and Saintfield.

The pleasant seaside resort of Bangor has greatly increased in population and has become a residential town for people who work in Belfast. Newcastle lies at the foot of the Mourne Mountains. Smaller resorts include Donaghadee, Ballywalter, Rostrevor, and Warrenpoint. Portavogie in the Ards Peninsula has a deep, modern harbour and is the base for a large fishing industry.

**History.** The countryside of County Down has abundant remains of people that lived there in prehistoric and early Christian times. The county has a special association with St. Patrick, who is said to be buried in the grounds of Downpatrick Cathedral. The cathedral stands on a mound overlooking the town, which takes its name from the Irish *Dun Phadraig* (Patrick's Fort). The first ca-





**St. Colman's Cathedral**, in Newry, County Down, is the cathedral of the Roman Catholic diocese of Dromore.

thedral to stand on the site was burned down, and the present one dates from the 1100's.

At the nearby village of Saul, according to legend, St. Patrick began his Christian missionary work in Ireland in about 432. In early Christian times, there were important monastic centres in Bangor and the Ards Peninsula. Later, Vikings raided Down, giving Strangford and Carlingford the Scandinavian names they now bear.

In the 1100's, eastern Ulster was invaded by Anglo-Norman barons led by John de Courcy. In the 1600's, Scottish settlers brought the language and culture of the Scottish Lowlands to the county of Down.

In 1798, Ballynahinch was the scene of a determined stand by Presbyterian rebels against the British Army. Soon afterward, the north and east of Down became noted for strong loyalty to the United Kingdom. South Down, where the population is mainly Roman Catholic, has much support for Irish nationalism.

**Downing Street**, in Westminster, London, has the official homes of the United Kingdom's prime minister and chancellor of the exchequer. The prime minister lives at number 10 and the chancellor at number 11, next door. The street is named after Sir George Downing, who built several of its houses in the late 1600's.

In 1732, George II offered number 10 to Sir Robert Walpole, who was prime minister at the time (see **Walpole, Sir Robert**). The front part of the house was rebuilt about 30 years later. In the 1960's, both number 10 and number 11 were rebuilt behind the old frontages.

**Downpatrick** is a town in Down, in Northern Ireland. It is named after St. Patrick, who is said to be buried there (see **Patrick, Saint**). The name *Downpatrick* comes from the Irish *Dún Phádraig*, which means *Patrick's fort*. According to tradition, St. Patrick landed at Saul, near Downpatrick, in A.D. 432. Later, he built a church at Downpatrick. In the 1100's, St. Malachy rebuilt it.

**Down syndrome**, formerly called *Mongolism*, is a disorder that is present at birth. It is characterized by mental retardation and such physical features as upward-slanting eyes; a flat nose; a small head; and short, stubby hands. In addition, the ears and teeth are small and abnormally shaped. Down syndrome may be ac-

companied by heart disorders, poor vision, and respiratory problems. The degree of mental retardation in children ranges from severe to mild.

Down syndrome is caused by an abnormality in the number of *chromosomes*. Chromosomes are the parts of a cell that contain tiny structures called *genes*, which determine hereditary traits. People with Down syndrome have 47 chromosomes instead of the normal 46. Scientists use special tests to examine the chromosomes in an unborn baby and to determine whether it has certain defects (see **Genetic counselling**).

Down syndrome appears in an average of 1 out of every 1,000 births. It can occur in people of every nationality and background. The risk of giving birth to a child who is afflicted by Down syndrome increases greatly after a woman reaches the age of 45.

Children with Down syndrome can be trained and can develop their full potential within the limits of their disability. Foster homes and various institutions care for the most severely retarded victims. Most experts recommend that children with less serious disabilities live at home. Studies show that, in general, children reared at home have a higher IQ and achieve more than those raised in institutions. Children who live at home can attend special classes. Many can be trained to do routine tasks and can learn simple skills.

Down syndrome was named after John Langdon Haydon Down, a British doctor who first described the condition in 1866. It was once called *Mongolism* because the facial features of young victims seemed to resemble those of Orientals.

**Downs** are generally treeless ranges of gently sloping hills. The name is used especially in England. They are mainly used for grazing livestock. The North and South Downs of southeastern England are chalk uplands. The North Downs start near Reigate, in Surrey. They extend generally eastward, through Surrey and Kent, reaching the coast around Dover and Folkestone. The South Downs begin near Petersfield, in Hampshire. They run close to the Sussex coast, meeting the sea at Beachy Head. *The Downs* is also the name of a deep-water sea channel between the coast of Kent and the Goodwin Sands. See **Goodwin Sands**.

**Dowry**. See **Marriage** (Marriage in other cultures).

**Dowser**. See **Divination**.

**Doyle, Sir Arthur Conan** (1859-1930), a British writer, created Sherlock Holmes, the world's best-known detective. Millions of readers have followed Holmes's adventures and delighted in his ability to solve crimes by an amazing use of reason and observation. Doyle wrote a story in 1893 in which Holmes was killed. But public demand forced Doyle to bring Holmes back to life in another story. Critic Christopher Morley said of Holmes, "Perhaps no fiction character ever created has become so charmingly real to his readers."

Doyle was born in Edinburgh, Scotland. He began practising medicine in 1882, but his practice was not a success. He started writing while waiting for the patients that never came. His early stories earned him little money, but he won great success with his first Holmes novel, *A Study in Scarlet* (1887).

Holmes appeared in 56 short stories and three other novels—*The Sign of Four* (1890), *The Hound of the Baskervilles* (1902), and *The Valley of Fear* (1915). Doyle



may have been the highest paid short-story writer of his time. He also wrote historical novels, romances, and plays. He eventually abandoned fiction to study and lecture on *spiritualism* (communication with spirits). For his efforts in support of the British cause during the Anglo-Boer War (1899-1902), Doyle received a knighthood in 1902. See also *Holmes, Sherlock*.

**D'Oyly Carte, Richard** (1844-1901), an English theatre manager, produced all but the first of the 14 operettas written by Sir William S. Gilbert and Sir Arthur S. Sullivan. D'Oyly Carte's production of Gilbert and Sullivan's second work, *Trial by Jury* (1875), established the team as a success. D'Oyly Carte used the profits from his productions of Gilbert and Sullivan's early operettas to build the Savoy Theatre in London in 1881. Gilbert and Sullivan's last eight operettas had their premières at the Savoy. Their works became known as *Savoy operas*, and performers and other people associated with them became known as *Savoyards*. In the 1880's, D'Oyly Carte founded the D'Oyly Carte Opera Company, to perform Gilbert and Sullivan operettas. The Savoy Theatre also staged works by other composers, including the Frenchman Jacques Offenbach. In 1891, Carte opened the lavish but unsuccessful Royal English Opera House to encourage serious English opera. It later became the Palace Theatre. See *Gilbert and Sullivan*.

**Drabble, Margaret** (1939- ), is an English novelist. She has become especially popular for her realistic portrayals of middle-class women struggling with the demands of careers, personal relationships, and other interests. Drabble's works have sometimes been criticized as rambling and plotless. But her best novels, particularly *The Needle's Eye* (1972), contain detailed and perceptive analyses of dilemmas modern women face.

Drabble's early novels, such as *A Summer Bird-Cage* (1963) and *The Garrick Year* (1964), are almost autobiographical studies of conflicts young women experience in their careers, marriages, and family lives. Her later novels, such as *The Realms of Gold* (1975) and *The Ice Age* (1977), include a larger number of characters who represent a cross-section of English society. In her later works, Drabble has also given more emphasis to current economic, political, and social concerns. For example, in *The Middle Ground* (1980) and *The Radiant Way* (1987), she focuses on how social change influences the lives of her characters. This theme of social concern is continued in *A Natural Curiosity* (1989), a sequel to *The Radiant Way*. Drabble has also written historical works and literary criticism. She edited the fifth edition of *The Oxford Companion to English Literature* (1985). Drabble was born in Sheffield.

**Draco** was a Greek lawmaker who introduced the first written code of law in ancient Athens in 621 B.C. The code was designed to reduce discontent caused by the unfairness of the Athenian justice system. The system had been based on unwritten laws known only to a few aristocratic judges, who often favoured the nobility. By putting laws into writing, Draco's code enabled people to find out for themselves what the laws were. Draco's code was said to be "written in blood" because it made almost all crimes punishable by death. Today, the word *Draconian* means *harsh* or *cruel*.

For the first time, the code made the government responsible for punishing a murderer. Previously, punish-

ment was left to the victim's family, and bloody feuds were common. Draco's code placed responsibility for upholding the law in the hands of the government of Athens. It helped Athens become one of the first city-states. The city-states were independent political units, each consisting of a city and its surrounding territory. **Dracula**, a novel by the English author Bram Stoker, is the most famous vampire story. The main character is a wicked nobleman, Count Dracula of Transylvania, Roma-



The novel *Dracula* was based on the legends that probably arose from murders, depicted above, committed in the 1400's.

nia. Dracula is a vampire—a corpse that returns to life at night, attacks people, and sucks their blood.

*Dracula* was based on vampire legends that probably arose from hundreds of savage murders committed in the 1400's by Vlad Tepes, a prince from Walachia, a region south of Transylvania. Stoker's novel, which was published in 1897, is probably best known as a film. Film versions of the novel include *Nosferatu, the Vampire* (1922) and *Dracula* (1931).

See also *Stoker, Bram; Vampire*.

**Draft** is a written order drawn by one party, directing a second party to pay a definite amount of money to a third party. Such a party may be an individual, a company, or a bank. Most drafts are used to finance business transactions when the buyer and seller are in different locations. A draft may also be drawn payable to the party that draws it. A draft may read *pay at sight* or *on demand*. In such cases, the draft is like a cheque, and the payer must pay immediately upon accepting the draft. A *time draft* is paid within an agreed time.



A draft is the same as a *bill of exchange* except that the term *draft* usually means a transfer of money between parties in the same country. Bills of exchange are frequently used for the transfer of money abroad. A draft drawn on a bank is a cheque. Cheques originate with the buyer, but trade drafts originate with the seller. Sellers of goods and services often use drafts to avoid the credit risk of open book accounts.

See also **Bill of exchange**; **Negotiable instrument**; **Note**.

**Draft, Military.** See **Conscription**.

**Drafter.** See **Technical drawing**.

**Drag.** See **Aerodynamics (Drag)**; **Streamlining**.

**Drag,** a means of transportation. See **Travois**.

**Drag racing.** See **Car racing (Drag racing)**; **Hot rod**.

**Dragline.** See **Construction equipment**.

**Drago, Luis María** (1859-1921), an Argentine statesman and jurist, supported the principle that became known as the *Drago Doctrine*. He was minister of foreign affairs in 1902, when Great Britain, Germany, and Italy aroused Latin America by blockading Venezuelan ports. He argued that no European country could use public debt as an excuse for armed intervention or for the occupation of American territory. The Hague Peace Conference of 1907 accepted Drago's doctrine.

Drago was born in Buenos Aires. He studied law, and became a judge of both the civil and criminal courts. Great Britain and the United States asked him to arbitrate the Atlantic fisheries dispute in 1909 and 1910. The Carnegie Endowment for International Peace invited him to visit the United States. It described Drago as the "most eminent exponent of intellectual culture in South America."

**Dragon** is a mythical beast in the folklore of many European and Asian cultures. Legends describe dragons as large, lizardlike creatures that breathe fire and have a long, scaly tail. In Europe, dragons are traditionally portrayed as ferocious beasts that represent the evils fought by human beings. But in Asia, especially in China and Japan, the animals are generally considered friendly creatures that ensure good luck and wealth.

Many European legends tell how a hero slew a dragon. For example, Apollo, a god of the ancient Greeks and Romans, once killed a dragon called Python. Saint

George, the patron saint of England, rescued a princess from a dragon by slaying the beast with a lance.

According to some medieval legends, dragons lived in wild, remote regions of the world. The dragons guarded treasures in their dens, and a person who killed one supposedly gained its wealth.

In China, the traditional New Year's Day parade includes a group of people who wind through the street wearing a large dragon costume. The dragon's image, according to an ancient belief, prevents evil spirits from spoiling the new year. Another traditional Chinese belief is that certain dragons have the power to control the rainfall needed for each year's harvest.

See also **Chen Rong**.

**Dragon of Komodo.** See **Komodo dragon**.

**Dragonfly** is a beautiful flying insect. It has four large, fragile wings which look like fine gauze. The wings shimmer and gleam in the sunlight when the insect flies. The dragonfly's long, slender body may be red, green, or blue, with white, yellow, or black markings. Large compound eyes, which look like beads, cover most of the head. The dragonfly can see motionless objects almost 2 metres away, and moving objects two or three times that distance. The insect has six legs covered with spines. It can use its legs to perch on a limb, but the legs are not adapted for walking. As it flies through the air, it holds its legs together to form a basket in which to capture insects. The dragonfly grasps its prey with its legs or jaws, and may eat it while flying.

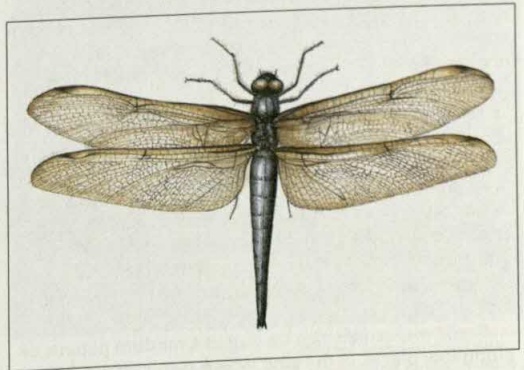
Dragonflies have been known to fly 80 to 97 kilometres an hour. They fly so swiftly that they usually escape from birds or other animals. Some extinct species of dragonflies had wingspans of over 75 centimetres.

Male and female dragonflies often fly together and sometimes mate while in flight. The female often deposits her eggs in the water or places them inside the stem of a water plant. The *nymph* (young dragonfly) hatches within one to three weeks. It has a thick body, big head and mouth, and no wings. It has a folding lower lip, called a *mask*, which is half as long as its body. The lip has jawlike hooks at the end and can move out to capture prey. The nymph breathes by means of gills.

The dragonfly nymph remains in the water for one to five years. It eats insects and small water animals. Some large dragonfly nymphs feed on young fish. While de-



**Saint George Slaying the Dragon** is a marble sculpture created in the early 1400's by the Italian sculptor Donatello.



A **dragonfly** has four large wings and can fly swiftly. It can attain speeds of up to 97 kilometres an hour.



veloping into an adult dragonfly, the nymph *moults* (sheds its skin) about 12 times. For its final moult, the nymph leaves the water and climbs onto a reed or rock. It then sheds its skin for the last time and emerges as an adult that soon can fly. Adult dragonflies live for only a few weeks to a few months.

Dragonflies are sometimes called *darners* and *devil's-darning-needles*. Other colourful local names used in North America and Australia include *mule killer* and *horse stinger*. However, dragonflies are harmless, they neither sting nor bite. In fact, they help people by feeding on harmful insects such as mosquitoes. Small, graceful *damsel flies* look like dragonflies, but have more slender, fragile bodies.

**Scientific classification.** Dragonflies and damsel flies belong to the class Insecta. They make up the order Odonata.

See also **Insect** (illustration: Incomplete metamorphosis).

**Drainage** is the removal of excess water from the soil. Plants cannot grow well in soil that is saturated with water. In most areas, water drains naturally from the soil. The water runs off or evaporates, or it is absorbed by the soil or by plants. In areas that do not drain naturally, artificial drainage systems are used to aid plant growth. Drainage systems are also used to make soil suitable for other purposes, including the construction of buildings and roads.

Excess water may accumulate in soil from rainfall, irrigation, or underground sources. Soils require drainage if they have water standing on their surface or if water fills the spaces between the soil particles. Soils also need to be drained if the area has a high *water table*. The water table is the level below which the soil is saturated. In soils that do not drain properly, the water table may rise almost to the surface of the ground. High water tables limit the growth of plant roots or cause them to rot. Drainage systems lower the water table, thus allowing air to enter the soil and enabling plants to grow normally.

In irrigated areas, drainage systems serve another purpose. Most irrigation water contains salts. After plants use this water, the salts remain in the soil. If allowed to accumulate, salts can reduce or prevent plant growth. Drainage systems ensure that these salts are carried away.

There are two main types of drainage systems—*surface drainage* and *subsurface drainage*. Both systems carry excess water to a suitable outlet, such as a pond or stream. A third system drains soils by means of wells and pumps. But this system is too costly under most conditions.

**Surface drainage** removes water before it soaks into the soil. It is used in areas that have flat lands and high rainfall, where water accumulates rapidly. It is also used to drain fine-textured soils, such as silt and clay, which do not absorb water quickly. Surface drainage systems consist of a series of shallow channels or deep ditches. The systems reduce the need for subsurface drainage, such systems being more costly to construct than surface drainage.

Shallow channels can be dug in a random pattern or along low places in the land where water runs off naturally. Ditches are used chiefly in large, flat areas. They are dug to a depth of 1 to 2 metres, usually in a parallel

series. They drain surface and underground water and can be used to control high water tables. But they obstruct the movement of people, machines, and animals. Other disadvantages are that they take up farmland and accumulate weeds.

**Subsurface drainage** is the usual method of lowering high water tables. Most subsurface drainage systems use a series of buried tubes or pipes. Drainage tubes are made of plastic and have small holes through which water enters. Drainage pipes consist of 30-centimetre clay segments called *tiles*, which are laid end to end. Water enters through the spaces between tiles. A layer of gravel, called an *envelope*, may be placed around the tubes or pipes to prevent soil from entering and plugging the system.

The tubes or pipes of subsurface drainage systems measure 10 to 25 centimetres in diameter, depending on how much water they must carry. They are buried 10 to 185 metres apart and 0.8 to 1.2 metres deep. The cost of laying the system increases with the depth. But the deeper the pipes are laid, the fewer are needed to drain the same amount of soil.

See also **Irrigation** (Providing artificial drainage).

**Draisine.** See **Bicycle** (Early bicycles; picture: The draisine).

**Drake** is the male duck. See **Duck**.

**Drake, Edwin Laurentine.** See **Petroleum** (Beginnings of the oil industry).

**Drake, Sir Francis** (1540?-1596), an explorer and military commander, was the first Englishman to sail around the world. His naval warfare against the Spaniards, the chief rivals of the English, helped England become a major sea power.

Drake was the most famous of the sea captains who roved the oceans during the rule of Queen Elizabeth I. The queen encouraged the "sea dogs," as the captains were called, to raid Spanish shipping. She gave them money and ships for such voyages, and she shared in the treasure they brought back. Drake lived in the great age of piracy and became one of the most feared pirates of his time.

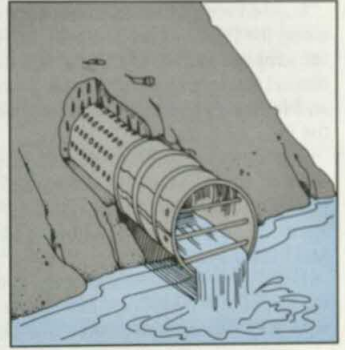
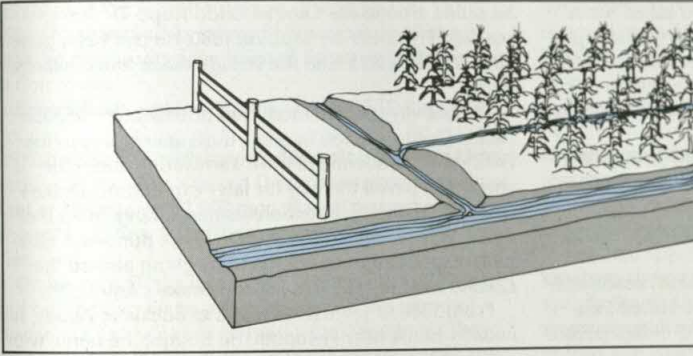
Drake had no formal education, but he had great self-confidence and ambition. In battle, he was courageous, quick, and sometimes merciless. He treated his crew kindly but, in return, he demanded loyalty and respect from his men.

**Early life.** Drake was born near Plymouth in Devon, England. In 1549, his family moved to Rochester, a seaport in Kent. Francis' father became a minister at nearby naval shipyards, and the boy grew up among ships and seamen. As a youth, Drake sailed on short commercial voyages along the English coast.

From 1566 to 1569, Drake sailed on two slave-trading voyages organized by his cousin, Sir John Hawkins, a famous sea dog. Hawkins obtained slaves in Africa and sold them to West Indian plantation owners. These voyages brought protests from both Portugal and Spain. Portugal did not want English competition in the slave trade, and Spain objected to English ships sailing in Caribbean waters. The slave-trading voyages gave Drake valuable sailing experience.

In 1567, Drake commanded the *Judith* on Hawkins' second expedition. On the return trip, the ships stopped at the Mexican port of San Juan de Ulúa, near Veracruz.





**Drainage systems** remove excess water from the soil. Surface drainage systems, *left*, consist of a series of channels or ditches. These systems carry away water before it soaks into the soil. Subsurface drainage systems use a series of tubes or pipes buried underground. Drainage tubes, *right*, have small holes through which water enters. The water is carried to a pond or other suitable outlet. These systems are more costly than surface drainage systems.

A fleet of Spanish ships approached the harbour, pretending to be friendly. But the Spaniards attacked the English, killing many English sailors and sinking several English vessels. Only the *Judith* and Hawkins' ship, the *Minion*, escaped. Drake returned to England hating the Spaniards and vowing to take revenge for what they had done.

From 1570 to 1572, Queen Elizabeth sent Drake on looting missions to the West Indies. In 1572, Drake seized several Spanish ships off the coast of Panama. He landed on the coast and captured the port of Nombre de Dios, near Colón. Drake then looted the town and ambushed a mule train carrying Peruvian silver across the Isthmus of Panama. From then on, the Spaniards called Drake *El Draque*, meaning *The Dragon*.

**Voyage around the world.** Drake's most famous voyage began on Dec. 13, 1577. He and more than 160 men sailed from Plymouth in the *Pelican*, the *Elizabeth*, and the *Marigold*. Two smaller ships, the *Swan* and the *Benedict*, carried supplies. The crewmen did not know the real destination or reasons for the voyage. Drake planned to explore the possibilities of trade and colonial settlement in the Pacific Ocean. He hoped to explore Australia, then known only as *Terra Australis Incognita* (the Unknown Southern Land). Drake also wanted to find the western outlet of the Northwest Passage (see *Northwest Passage*). Drake and the queen secretly planned that he would loot Spanish ships and colonies along the Pacific coast of South America.

After leaving São Tiago in the Cape Verde Islands, Drake's expedition met two Portuguese ships. Drake captured one of the vessels and gave its command to a friend, Thomas Doughty. The ships sailed south along the Atlantic coast of South America and ran into violent storms. The expedition then stopped at San Julián for supplies. There, Drake had Doughty beheaded because he suspected him of planning a mutiny.

Before leaving San Julián, Drake destroyed the supply ships and the captured Portuguese ship because they were in poor condition and he did not think they could complete the voyage. The three remaining ships sailed through the Strait of Magellan. Shortly afterward, violent storms wrecked the *Marigold*. The storms also blew the

*Elizabeth* off course and forced it to return to England. Drake continued in the last ship, the *Pelican*, which he renamed the *Golden Hind*. He headed north along the Pacific coast of South America. The Spaniards had left their coastal ports unguarded because until then, only Spanish ships had sailed the Pacific. After raiding several Spanish settlements, Drake captured a Spanish ship, the *Cacafuego*, and stole its cargo of gold, silver, and jewels.



Oil painting by an unknown artist; National Maritime Museum, Greenwich, England

**Sir Francis Drake**, a daring English seaman and pirate, helped England become a mighty sea power. Queen Elizabeth I knighted Drake in 1581 after he had sailed around the world.



Loaded with treasure, the *Golden Hind* sailed north along the Pacific coast of North America. Drake stopped for supplies just north of what is now San Francisco and named the area New Albion. He found the people there so friendly that he nailed to a post a brass plate claiming the land for England.

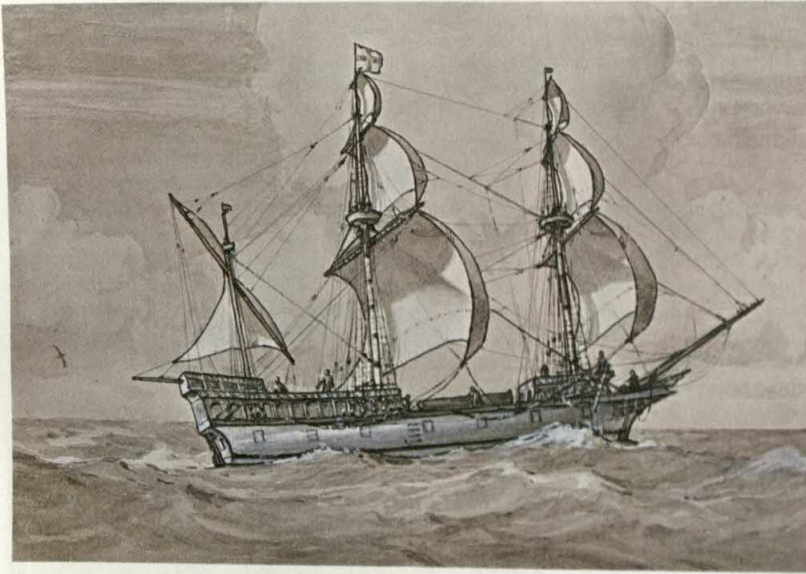
Drake had planned to return to England through the Strait of Magellan, not to sail around the world. But he feared an attack by the Spaniards if he sailed south again. So he decided to sail home by way of the Pacific and Indian oceans.

Drake stopped for water at the Philippine Islands and for spices at the Molucca Islands. He also visited Sulawesi (Celebes) and Java. After crossing the Indian Ocean,

he sailed around the Cape of Good Hope. Drake reached Plymouth on Sept. 26, 1580. He had been gone almost three years, and the voyage made him a national hero.

Drake's voyage also increased British interest in the Pacific Ocean and led to many trading ventures in the Far East. It broadened English knowledge about the world and paved the way for later exploration. Drake's raids on Spanish possessions angered King Philip II of Spain, and he demanded that Drake be punished. Elizabeth responded to this demand by going aboard the *Golden Hind* in 1581 and making Drake a knight.

From 1580 to 1585, Drake lived at Buckland Abbey, his country home near Plymouth. He bought the home with



**The *Golden Hind*** was Sir Francis Drake's ship during his voyage around the world from 1577 to 1580. It was about 23 metres long and had 18 guns. Approximately 50 men finished the famous voyage with Drake.

**Drake's voyage around the world, 1577-1580**

This map shows the route Drake followed on his voyage around the world. After passing the Strait of Magellan, Drake raided Spanish ships along the western coast of South America. The voyage made Drake the first Englishman to sail around the world.





his share of the wealth from the voyage. In 1581 and 1582, Drake served as mayor of Plymouth. In 1584 and 1585, he represented the town of Bossiney in the House of Commons.

**Expeditions against Spain.** In May 1585, King Philip ordered an embargo on English goods in Spain and on English ships in Spanish ports. His action angered Elizabeth. In September, she put Drake in command of a fleet of 25 ships and 2,000 men. He left that autumn with orders to capture Spanish treasure ships in the West Indies.

On his way, Drake looted the Spanish port of Vigo and burned São Tiago. After landing on the island of Hispaniola, Drake's men burned Santo Domingo. They later occupied the town of Cartagena for six weeks and held it to ransom. On the return voyage, Drake looted and burned St. Augustine. He then sailed north to the Virginia Colony and took colonists back to England.

Meanwhile, Philip had begun to gather Spain's warships into a fleet called the *Invincible Armada*. The Spaniards gave their fleet this name because they thought it could not be defeated. Philip planned a great attack on England, but Elizabeth learned of his intention. She sent Drake to the Spanish port of Cádiz, where he sank about 30 ships and seized supplies.

Yet, Drake could not prevent the Armada from sailing in May 1588. He proposed a plan to attack the Armada along the coast of Portugal, but the plan was not approved in time. The queen appointed Drake vice admiral of the English fleet.

In the summer of 1588, in the English Channel, the English and Spanish fleets fought one of history's greatest naval battles. Drake commanded a large group of warships from his ship, the *Revenge*. He played an important part in the Battle of Gravelines, in which the English sank or captured many Spanish ships. The surviving ships of the Armada fled into the North Sea, hoping to find a friendly port in Ireland. But storms wrecked many of the ships and the Irish killed several Spaniards who landed.

**Later life.** In 1589, Drake led a fleet in a raid on Lisbon, which was then a Spanish port. He seized much treasure at Lisbon, but a storm destroyed many of the ships in his fleet. Thousands of English sailors died on the voyage, and Elizabeth called it a failure. Drake lost

the queen's approval and received no commands for almost six years. Drake retired to Buckland Abbey and, in 1593, he represented Plymouth in the House of Commons.

Drake's last voyage took place in 1595, when he and Sir John Hawkins again sailed to the West Indies. Hawkins died as the fleet reached the islands. Drake went on and destroyed many towns, including Nombre de Dios. While returning with treasure, he died of dysentery. His crew buried him at sea.

See also **Spanish Armada**.

**Drakensberg** is the most important range of mountains in South Africa. The range is more than 1,000 kilometres long. It extends from the Stormberg Mountains in the Cape Province, through the Orange Free State and Natal to the Wolkberg Mountains in the eastern Transvaal. In most places, the mountain range forms part of the *Great Escarpment*, a semicircular series of cliffs separating the high inland plateau from the lower coastal belt. The highest peak in the range is Thaba Ntlenyana which rises 3,482 metres in Lesotho. South Africa's highest point, the 3,375-metre Champagne Castle, is also located in the Drakensberg. Other high peaks in the range include Giants Castle (3,313 metres), Mont-aux-Sources (3,299 metres), Cathkin Peak (3,148 metres), and Cathedral Peak (3,004 metres).

The mountains act as South Africa's main watershed, separating the rivers that flow into the Atlantic Ocean from those that flow into the Indian Ocean. Several of the country's major rivers originate in the Drakensberg. Mont-aux-Sources gives rise to the Tugela, Orange, and Elands rivers. The Tugela Falls, at the Mont-aux-Sources *amphitheatre* (area surrounded by mountains), plunge 2,000 metres in a series of falls. They are the highest falls in southern Africa.

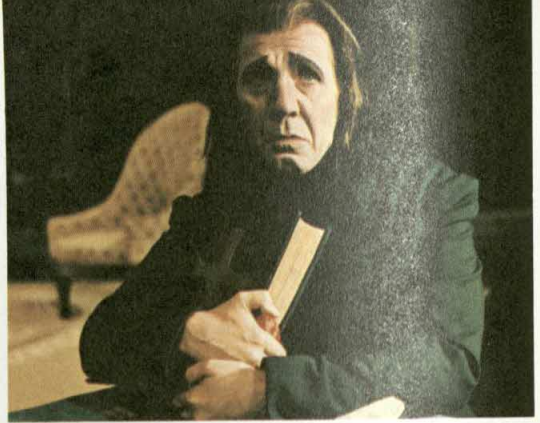
The mountains originated about 150 million years ago when volcanic lava cooled and solidified forming basalt which comprise the high peaks. The Drakensberg were a main area of San settlement (see **Khoisan**). Magnificent San paintings can still be seen in several caves. The Zulu and Sotho peoples regarded the mountains as "a barrier of pointed spears." The Dutch settlers saw the peaks as the "home of dragons" or "dragon mountains," which is the origin of the name Drakensberg.

**Dram.** See **Apothecaries' weight**.

**The Drakensberg Mountains** are South Africa's main watershed. They separate the rivers that flow into the Atlantic Ocean from those that flow into the Indian Ocean.





Falstaff in Shakespeare's *Henry IV, Part 1*Tartuffe in Molière's *Tartuffe*Willy Loman in Arthur Miller's *Death of a Salesman*

## Drama

**Drama** is an art form that tells a story through the speech and actions of the characters in the story. Most drama is performed by actors who impersonate the characters before an audience in a theatre, or before television cameras for an audience in their homes.

Although drama is a form of literature, it differs from other literary forms in the way it is presented. For example, a novel also tells a story involving characters. But a novel tells its story through a combination of dialogue and narrative, and is complete on the printed page. Most drama achieves its greatest effect when it is performed. Some critics believe that a written script is not really a play until it has been acted before an audience.

Drama probably gets most of its effectiveness from its ability to give order and clarity to human experience. The basic elements of drama—feelings, desires, conflicts, and reconciliations—are the major ingredients of human experience. In real life, these emotional experiences often seem to be a jumble of unrelated impressions. In drama, however, the playwright can organize these experiences into understandable patterns. The audience sees the material of real life presented in meaningful form—with the unimportant omitted and the significant emphasized.

Drama is a universal art. Nearly every civilization has had some form of it. Drama is also an ancient art. Staged performances using actors took place as long ago as

500 B.C., and probably occurred even earlier. But scholars have insufficient evidence to state definitely when drama first began. Nor do they know for certain what led to the creation of drama. However, they propose a number of theories. One theory suggests that drama may have developed from ancient religious ceremonies that were performed to win favour from the gods. In these ceremonies, priests often impersonated supernatural beings or animals, and sometimes imitated such actions as hunting. Stories grew up around some rites and lasted after the rites themselves had died out. These myths may have formed the basis of drama.

Another theory suggests that drama originated in choral hymns of praise sung at the tomb of a dead hero. At some point, a speaker separated from the chorus and began to act out deeds in the hero's life. This acted part gradually became more elaborate, and the role of the chorus diminished. Eventually, the stories were performed as plays, their origins forgotten.

According to a third theory, drama grew out of a natural love of storytelling. Stories told around campfires re-created victories in the hunt or in battle, or the feats of dead heroes. These stories developed into dramatic retellings of the events.

This article describes the history of drama. For a discussion of modern theatre arts, see the *World Book* article on Theatre.



Among the many forms of Western drama are (1) tragedy, (2) serious drama, (3) melodrama, and (4) comedy. Many plays combine forms. Modern dramatists often disregard these categories and create new forms.

**Tragedy** maintains a mood that emphasizes the play's serious intention, though there may be moments of comic relief. Such plays feature a *tragic hero*, an exceptional yet flawed individual who is brought to disaster and usually death. The hero's fate raises questions about the meaning of existence, the nature of fate, morality, and social or psychological relationships. Aristotle identified the emotional effect of tragedy as the "*catharsis* [emotional release] of pity and fear."

**Serious drama**, which developed out of tragedy, became established in the 1800's. It shares the serious tone and often the serious purpose of tragedy and, like tragedy, it concentrates on unhappy events. But serious drama can end happily, and its heroes are less imposing and more ordinary than the tragic hero. Serious drama is sometimes viewed as tragedy's modern successor.

**Melodrama** involves a villain who initiates actions that threaten characters with whom the audience is sympathetic. Its situations are extreme and often violent, though endings are frequently happy. Melodrama portrays a world in which good and evil are clearly distinguished. As a result, almost all melodramas have a sharply defined, oversimplified moral conflict.

**Comedy** tries to evoke laughter, often by exposing the pretensions of fools and rascals. Comedy usually ends happily. But even in the midst of laughter, comedy can raise surprisingly serious questions. Comedy can be both critical and playful, and it may arouse various responses. For example, *satiric comedy* tries to arouse



A kabuki play in Japan

scorn, while *romantic comedy* tries to arouse joy.

Farce is sometimes considered a distinct dramatic form, but it is essentially a type of comedy. Farce uses ridiculous situations and broad physical clowning for its humorous effects.

## The structure of drama

Aristotle, a Greek philosopher who lived in the 300's B.C., wrote the earliest surviving and most influential essay on drama, called *Poetics*. In it, he identified the parts of a tragedy as (1) plot, (2) character, (3) thought, (4) diction, (5) music, and (6) spectacle. These six elements are fundamental to all types of drama, not just tragedy. In a well-written play, all of the elements combine to form a unified, coherent, and purposeful sequence of incidents.

**Plot** is a term sometimes used to mean a summary of a play's story. More properly, it means the overall structure of the play. In this sense, it is the most important element of drama. The beginning of a play includes *exposition*, which gives the audience information about earlier events, the present situation, or the characters. Early in most plays, the author focuses on a question or a potential conflict. The author brings out this question or conflict through an *inciting incident* which sets the action in motion. The inciting incident makes the audience aware of a *major dramatic question*, the thread that holds the events of the play together.

Most of the play involves a series of *complications*—discoveries and decisions that change the course of action. The complication leads to a *crisis*, a turning point when previously concealed information is at least partly revealed and the major dramatic question may be answered. The final part of the play, often called the *reso-*

*lution*, extends from the crisis to the final curtain. It pulls together the various strands of action and brings the situation to a new balance, thus satisfying the expectations of the audience. Writers of modern drama often ignore these traditional aspects of plot.

**Character** is the principal material from which a plot is created. Incidents develop mainly through the speech and behaviour of dramatic characters. The characters must be shaped to fit the needs of the plot, or the plot must be shaped to fit the needs of the characters.

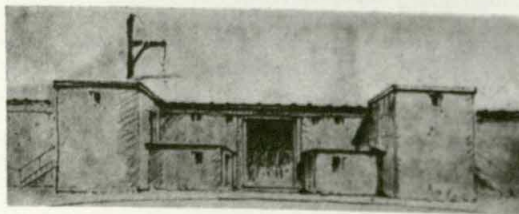
**Thought.** Every play, even the most light-hearted comedy, involves thought in its broadest sense. In dramatic structure, thought includes the ideas and emotions implied by the words of all the characters. Thought also includes the overall meaning of the play, sometimes called the *theme*. Not all plays explore significant ideas. But every play makes some comment on human experience, either through direct statement or, more commonly, by implication.

**Other parts of drama.** *Diction*, or *dialogue*, is the use of language to create thought, character, and incident. *Music* involves either musical accompaniment or, more commonly today, the arranged pattern of sound that makes up human speech. *Spectacle* deals with the visual aspects of a play, especially the physical actions of the characters. Spectacle also refers to scenery, costumes, makeup, stage lighting, and props.





**Ancient Greek theatres** were outdoor amphitheatres that seated thousands of spectators for annual contests in acting, choral singing, and writing comedy and tragedy. Scholars are not sure what the stages looked like. These drawings show some possible reconstructions of the stage house of the Theatre of Dionysus.



Western drama was born in ancient Greece. Much of our knowledge of Greek theatre comes from archaeological studies and historical writings of the time. By the 600's B.C., the Greeks were giving choral performances of dancing and singing at festivals honouring Dionysus, their god of wine and fertility. Later, they held drama contests to honour Dionysus. The earliest record of Greek drama dates from about 534 B.C., when a contest for tragedy was established in Athens. Thespis, who was the winner of the first competition, became the earliest known actor and dramatist. The word *thespian* comes from his name.

The most important period of ancient Greek drama was the 400's B.C. Tragedies were performed as part of an important yearly religious and civic celebration called the *City Dionysia*. This festival, which lasted several days, offered hotly contested prizes for the best tragedy, comedy, acting, and choral singing.

The Greeks staged performances in the Theatre of Dionysus, on the slope below the Acropolis in Athens. The theatre seated about 14,000 people. It consisted of rows of stadium-like seats that curved about halfway around a circular acting area called the *orchestra*. Beyond the circle and facing the audience was the *skene* (stage house), originally used as a dressing area and later as a background for the action. This structure eventually developed into a long building with side wings called *paraskenia* projecting toward the audience. The *skene* probably had three doors. The action may have taken place on a raised platform, or perhaps entirely in the orchestra. See *Europe* (picture: Ancient Greek drama).

**Tragedy.** Greek tragedy, perhaps because it originally was associated with religious celebrations, was solemn, poetic, and philosophic. Nearly all the surviving tragedies were based on myths. Typically, the main character was an admirable, but not perfect, person confronted by a difficult moral choice. This character's struggle against hostile forces ended in defeat and, in most Greek tragedies, his or her death.

Greek tragedies consisted of a series of dramatic episodes separated by choral odes (see *Ode*). The episodes were performed by a few actors, never more than three on stage at one time, during the 400's B.C. A chorus danced and sang and chanted the odes to musical accompaniment.

The actors wore masks to indicate the nature of the characters they played. Men played women's roles, and the same actor appeared in several parts. The acting style, by modern standards, was probably far from realistic. The poetic language and the idealized characters suggest that Greek acting was dignified and formal. The dramatist usually staged his own plays. A wealthy citizen called the *choregus* provided the money to train and costume the chorus.

Of the hundreds of Greek tragedies written, fewer than 35 survive. All but one were written by three dramatists—Aeschylus, Sophocles, and Euripides.

Aeschylus, the earliest of the three, won 13 contests for tragedy. His plays are noted for their lofty tone and majestic language. He was the master of the *trilogy*, a dramatic form consisting of three tragedies that focus on different phases of the same story. His *Oresteia*, the only surviving Greek trilogy, tells how Clytemnestra killed her husband, Agamemnon, and was then killed by





**Menander** was the most popular Greek playwright of his time. This bas-relief shows him with masks worn in comedies. The woman on the right may represent Thalia, the goddess of comedy.

their son Orestes. This trilogy traces the development of the idea of justice from primitive vengeance to enlightened, impersonal justice administered by the state. This development is portrayed in a powerful story of murder, revenge, remorse, and divine mercy. The chorus is important in Aeschylus' plays.

Sophocles is the playwright whose work served as the primary model for Aristotle's writing on tragedy. Sophocles seems today the most typical of the Greek tragic playwrights. His plays have much of Aeschylus' philosophic concern, but his characters are more fully drawn and his plots are better constructed. He was also more skilful in building climaxes and developing episodes. Aeschylus used only two characters on stage at a time until Sophocles introduced a third actor. This technique increased the dramatic complexity of Greek drama. Sophocles also reduced the importance of the chorus. His most famous play, *Oedipus Rex*, is a masterpiece of suspenseful storytelling and perhaps the greatest Greek tragedy.

Euripides was not widely appreciated in his own day, but his plays later became extremely popular. Euripides is often praised for his realism. His treatment of traditional gods and myths shows considerable doubt about religion, and he questioned moral standards of his time. Euripides showed his interest in psychology in his many understanding portraits of women. His *Medea* describes how a mother kills her children to gain revenge against their father.

Euripides used a chorus, but did not always blend it well with the episodes of his tragedies. He is sometimes criticized for his dramatic structure. Many of his plays begin with a prologue summarizing past events and end with the appearance of a god who resolves a seemingly impossible situation.

**Satyr plays.** Each playwright who competed in the contests at the City Dionysia had to present three tragedies and then a satyr play. The satyr play, a short comic parody of a Greek myth, served as a kind of humorous afterpiece to the three tragedies. It may be even older than tragedy. The satyr play used a chorus performing as *satyrs* (mythical creatures that were half human and

half animal). The actors and chorus in the tragedies also appeared in the satyr play.

Only one complete satyr play still exists—Euripides' *Cyclops*. It is a parody of Odysseus' encounter with the monster Cyclops. The satyr play was a regular part of the Athenian theatre during the 400's B.C. But this form of play disappeared when Greek drama declined after the 200's B.C.

**Old Comedy.** Greek playwrights did not mix tragedy and comedy in the same play. Greek Old Comedy, as the comic plays of the 400's are called, was outspoken and bawdy. The word *comedy* comes from the Greek word *komoidia*, which means *merrymaking*.

In the first scene of a typical Old Comedy, a character suggests the adoption of a *happy idea*. For example, in the comedy *Lysistrata* by Aristophanes, the women of Athens figure out a way to stop their men from going to war. After a debate called an *agon*, the proposal, sometimes greatly changed, is adopted. The rest of the play shows the humorous results. Most of these plays end with a *komos* (an exit to feasting and merrymaking).

The only surviving examples of Old Comedy are by Aristophanes. He combined social and political satire with fantasy, robust farce, obscenity, personal abuse, and beautiful lyric poetry. Aristophanes was a conservative who objected to the social, moral, and political changes occurring in Athenian society. In each of his plays, he ridiculed and criticized some aspect of the communal life of his day.

**New Comedy.** Tragedy declined after 400 B.C., but comedy remained vigorous. Comedy changed so drastically, however, that most comedies written after 338 B.C. are called New Comedy. In spite of its popularity, only numerous fragments and a single play have survived. The play is *The Grouch* by Menander, the most popular playwright of his time. Most New Comedy dealt with the domestic affairs of middle-class Athenians. Private intrigues replaced the political and social satire and fantasy of Old Comedy. In New Comedy, most plots depended on concealed identities, coincidences, and recognitions. The chorus provided little more than interludes between episodes.



After the 200's B.C., Greek drama declined and leadership in the art began to pass to Rome. Today, Greek drama is much more highly regarded than Roman drama, which for the most part imitated Greek models. Roman drama is important chiefly because it influenced later playwrights, particularly during the Renaissance. William Shakespeare and the other dramatists of his day knew Greek drama almost entirely through Latin imitations of it.

In Rome, tragedy was less popular than comedy, short farces, pantomime, or such nondramatic spectacles as battles between gladiators. Roman theatres were adaptations of Greek theatres. The government supported theatrical performances as part of the many Roman religious festivals, but wealthy citizens financed some performances. Admission to theatrical performances was free and audiences were unruly in the brawling, holiday atmosphere.

**The Roman stage** was about 30 metres long and was about 1.5 metres above the level of the orchestra. The back wall of the stage represented a *façade* (building front) and probably had three openings. In comedies, each of these openings was treated as an entrance to houses, and the stage became a street scene. Scholars disagree on whether the back wall was flat or three-dimensional.

**Tragedy** was introduced in Rome by Livius Andronicus in 240 B.C. But the dramatic works of only one Roman tragedian, Lucius Annaeus Seneca, still exist. Seneca's plays probably were never performed during his lifetime. His nine surviving plays were based on Greek originals. These plays are not admired today. However, they were extremely influential during the Renaissance.

Later Western dramatists borrowed a number of techniques from Seneca. These techniques included the five-act form; the use of elaborate, flowery language; the theme of revenge; the use of magic rites and ghosts; and the device of the *confidant*, a trusted companion in whom the leading character confides.

**Comedy.** The only surviving Roman comedies are the works of Plautus and Terence. All their plays were adaptations of Greek New Comedy. Typical plots revolved around misunderstandings. These misunderstandings frequently were based on mistaken identity, free-spending sons deceiving their fathers, and humorous intrigues invented by clever slaves. Plautus and Terence eliminated the chorus from their plays, but they added



**Roman comedy** was usually performed on a stage that represented a public street. The back wall had openings through which the actors entered and exited. Most Roman comedies included musical accompaniment and many songs. Actors wore comic masks.

many songs and much musical accompaniment. Plautus' humour was robust, and his plays were filled with farcical comic action. Terence avoided the broad comedy and exaggerated characters of Plautus' plays. Terence's comedies were more sentimental and more sophisticated and his humour more thoughtful. His six plays had a strong influence on later comic playwrights, especially Molière in France in the 1600's.

**Minor forms** of drama were popular in Rome, but no examples of these forms exist today. The *mime*, a short and usually comic play, was often satiric and obscene. In the *pantomime*, a single dancer silently acted out stories to the accompaniment of choral narration and orchestra music.

The Roman theatre gradually declined after the empire replaced the republic in 27 B.C. The minor dramatic forms and spectacles became more popular than regular comedy and tragedy. Many of these performances were sensational and indecent, and offended the early Christians. In the A.D. 400's, actors were excommunicated. The rising power of the church, combined with invasions by barbarian tribes, brought an end to the Roman theatre. The last known performances in ancient Rome took place in A.D. 533.

## Medieval drama

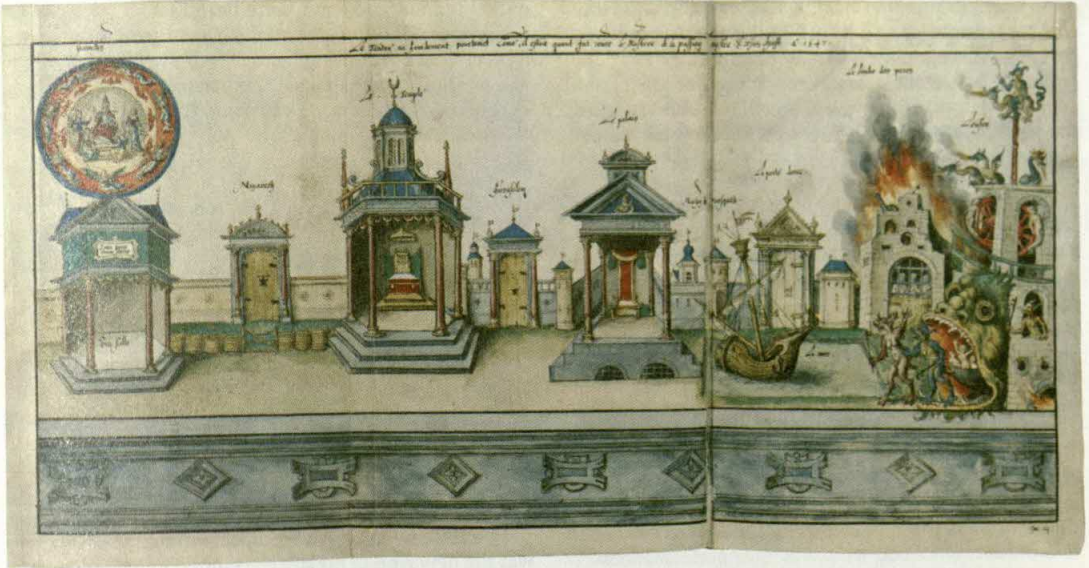
Although state-supported drama ended in the A.D. 500's, scattered performances by travelling mimes and troubadours probably continued throughout the Middle Ages. The plays of Plautus, Terence, and Seneca were preserved by religious orders which studied them not as plays but as models of Latin style.

Medieval drama flourished from the 900's to the 1500's, and became increasingly diverse. It was gradually suppressed, however, because of the religious strife associated with the Reformation. By 1600, religious drama had almost disappeared in every European country except Spain.

**Liturgical drama.** The rebirth of drama began in the 900's with brief playlets acted by priests as part of the *liturgy* (worship service) of the church. The Resurrection was the first event to receive dramatic treatment. A large body of plays also grew up around the Christmas story, and a smaller number around other Biblical events. In the church, the plays were performed in Latin by priests and choirboys.

**Mystery plays.** Beginning in the 1200's, plays were moved outdoors. Plays written after this time are often called *mystery plays*. These plays, which were written in verse, taught Christian doctrine by presenting Biblical





**Mansion stages** were popular in medieval Europe. They consisted of separate settings on a long platform. The actors moved from one setting to another, following the action of the play.



Illustration from *A Dissertation on the Pageants or Dramatic Mysteries Anciently Performed at Coventry* by Thomas Sharp, courtesy Oscar G. Brockett

**Pageant wagons** were travelling stages used to present drama in medieval England. Audiences stood in the street or saw the plays from nearby houses. The actors were townspeople.

characters as if they lived in medieval times. Many mystery plays were rich with comedy.

During the 1300's, the performance of mystery plays was taken over by such *secular* (nonreligious) organizations as trade guilds. The *vernacular* (local language) replaced Latin. The short plays had been staged throughout the year. But by the 1300's, they were often given as a group called a *cycle*. A cycle portrayed the entire Christian story of the relationship between God and human beings, from the creation of the world to the final judgment. It included an account of the life, death, and Resurrection of Jesus Christ. Cycles usually were performed during the summer.

Cycles of mystery plays from four English towns—Chester, Lincoln, Wakefield, and York—have been preserved. All date from the 1300's. Plays from France, Italy, Spain, and elsewhere have also survived.

In England, the setting for each play was mounted on a *pageant wagon*. This wagon was drawn through a city to various places where audiences gathered. Because of the limited space, the actors probably performed on a platform beside the wagon. The audience usually stood in the street or watched the performance from nearby houses. The actors were townspeople, and most of them belonged to the trade guilds that financed and produced the plays.

In various cities on the European continent, several *mansions* (miniature settings) were erected on a long platform. The actors moved from one of these settings to another, according to the action of the play. See *Mystery play*.

**Miracle plays and morality plays** were also popular during the Middle Ages. Miracle plays dramatized events from the lives of saints or the Virgin Mary. The action in most of these plays reached a climax in a miracle performed by the saint. Morality plays used allegorical characters to teach moral lessons. These dramas



grew from fairly simple religious plays into secular entertainments performed by professional acting companies. See *Miracle play*; *Morality play*.

**Farces and interludes.** Purely secular drama achieved its greatest development in two short forms of drama—the farce and the interlude. Farces were almost

entirely comic, and many were based on folk tales. Interludes originally were entertaining skits, probably acted between courses during banquets or at other events. The interlude was especially associated with the coming of professional actors who became regular parts of many noble households.

### Italian Renaissance drama

Even before the development of the theatre in England and Spain, the Renaissance had begun to transform Italian drama. A new interest in ancient Greece and Rome extended to the drama, and classical plays were studied for the first time as drama, not just as literature. Italian critics of the 1500's wrote essays based on Aristotle's *Poetics* and Horace's *Art of Poetry*. From these essays grew a movement known later as *neoclassicism*.

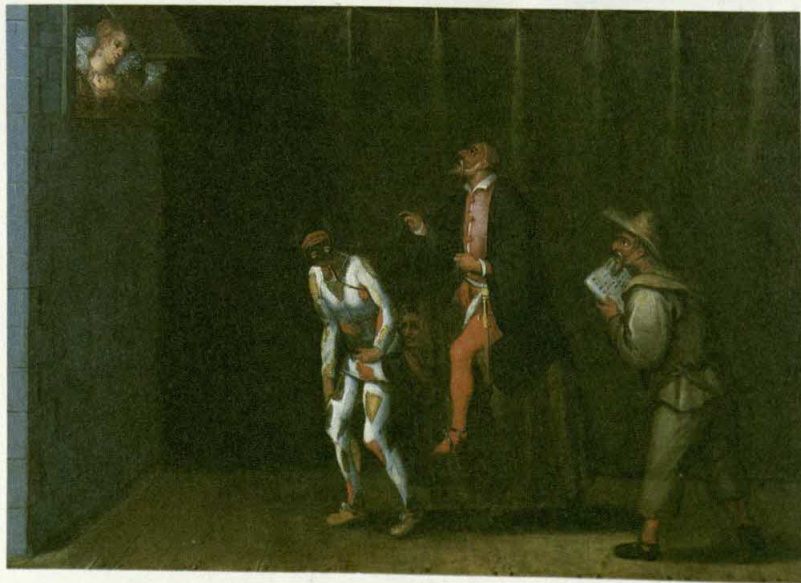
The centres of Italian theatrical activity were the royal courts and the academies, where authors wrote plays that imitated classical drama. These plays were produced in small private theatres for the aristocracy. Most of the actors were courtiers, and most performances were a part of court festivities.

There were three types of plays—comedy, tragedy, and *pastoral*. Pastoral drama dealt with love stories about woodland goddesses and shepherds in idealized rural settings. Few Italian Renaissance plays had much artistic value. But they are important historically because they departed from the shapelessness of medieval drama and moved toward greater control of plot. Ludovico Ariosto was the first important comic writer. His comedies *Cassaria* (1508) and *I Suppositi* (1509) are considered the beginning of Italian drama. *La Mandragola* (about 1520), a comedy by the statesman and writer Niccolò Machiavelli, is still admired and performed. The first important tragedy was *Sofonisba* (1515), by Giangiorgio Trissino, who followed the Greeks rather than Seneca.

**Intermezzi and operas.** To satisfy the Italian love of spectacle, the *intermezzo*, a new form, developed from the court entertainments popular at that time. The intermezzi were performed between acts of regular plays. They drew flattering parallels between mythological figures and people of the day, and provided opportunities for imaginative costumes and scenery. After 1600, the intermezzi were absorbed into opera, which originated in the 1590's from attempts to reproduce Greek tragedy. By 1650, opera had become the most popular dramatic form in Italy.

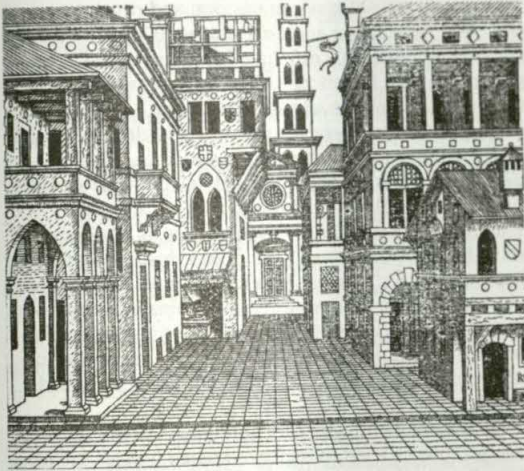
**The Italian stage.** More important than the plays was the new type of theatre developed in Italian courts and academies. Italian scenic designers were influenced by two traditions—the Roman façade theatres and the newly acquired knowledge of perspective painting. In 1545, Sebastiano Serlio published the first Italian essay on staging. He summarized contemporary methods of adapting the Roman theatre for use indoors. Serlio's designs show semicircular seating in a rectangular hall and a wide, shallow stage. Behind the shallow stage was a *raked* (tilted) stage on which painted sets created a perspective setting. Serlio's three stage designs—for comedy, tragedy, and pastoral dramas—were widely imitated.

The Roman façade was recreated in the Teatro Olimpico, Italy's first important permanent theatre, which opened in 1585. A *perspective alley* showing a view down a city street was placed behind each of seven



**Commedia dell'arte** was a loosely-constructed form of comedy that dominated Italian drama from the 1500's through the 1700's. A stock group of characters appeared in all commedia plays.





**Scenic designs by Sebastiano Serlio** popularized perspective settings in Renaissance drama. His designs for comedy, tragedy, and satire were based on the classical Roman stage.

openings in the façade. A more significant development of the façade appeared in the Teatro Farnese, built in 1618. This theatre had the first permanent *proscenium*

*arch*, a kind of large frame that enclosed the action on stage. It was especially suited for perspective settings. In 1637, the first public opera house opened in Venice. There, earlier developments helped create the *proscenium* stage that dominated theatre until the 1900s.

**Commedia dell'arte** was the name given to boisterous Italian plays in which the actors *improvised* (made up) the dialogue as they went along. Commedia was a truly popular form in Italian, as opposed to the literary drama of the court and academies. Commedia was performed by professional actors who worked as easily on simple platforms in a market square as they did on elaborate court stages.

The commedia script consisted of a *scenario* (outline of the basic plot). Characters included such basic types as Harlequin the clown and Pantaloon the old man. In each company, the same actor always played the same role. Most of the lively, farcical plots dealt with love affairs, but the main interest lay in the comic characters. Scholars do not know how commedia originated, but by 1575 the companies that performed it had become extremely popular in Italy. Commedia soon was appearing throughout Europe. It remained a vigorous force in drama until the mid-1600s, and continued to be performed until the end of the 1700s. Commedia had an important influence on much of the comedy written during the 1600s.

## Elizabethan, Jacobean, and Caroline drama

The Reformation directly affected the history of drama by promoting the use of national languages rather than Latin. The use of these languages led to the development of national drama. The first such drama to reach a high level of excellence appeared in England between 1580 and 1642. Elizabethan drama was written mainly during the last half of the reign of Queen Elizabeth I, from about 1580 to 1603. Jacobean drama was written during the reign of King James I (1603-1625). William Shakespeare, the greatest dramatist of the age, bridged the Elizabethan and Jacobean periods, but he generally is considered an Elizabethan playwright. Caroline drama was written in the reign of King Charles I (1625-1649).

**Elizabethan theatres.** The first public theatre in England, called The Theatre, was built near London in 1576. By 1642, there had been at least nine others in and around London, including the Globe, Rose, and Fortune.

All Elizabethan public theatres had the same basic design. A large unroofed area called the *yard* was enclosed by a three-storeyed, gallery-type structure that was round, square, or octagonal. A large, elevated platform stage projected into the yard and served as the theatre's principal acting area. The audience stood in the yard or sat in the galleries, watching the play from three sides.

At the rear of the platform stood a two- or three-storey façade. On the stage level, the façade had two doors that served as the principal entrances. Another acting area on the second level was used to represent balconies, walls, or other high places. Some theatres had a façade with a third level where the musicians sat. The specific place of the dramatic action was indicated pri-

marily through descriptive passages in the play's dialogue. A few pieces of scenery were used. This theatre design was ideal for Elizabethan plays, which moved at a rapid pace and had many scenes.

Performances began in the early afternoon and lasted until just before dusk. Women never appeared on the professional stage. Boys played women's roles, and some acting companies consisted entirely of boys. All classes of society attended the theatre, and refreshments were sold during performances.

**Elizabethan playwrights.** Elizabethan plays developed from the interludes performed by wandering actors, and the classically inspired plays of schools and universities. These two traditions merged in the 1580s when a new group of playwrights, many of them university-educated, began writing for professional actors of the public theatre.

Thomas Kyd is important in the history of drama because he brought classical influence to popular drama. Kyd wrote the most popular play of the 1500s, *The Spanish Tragedy* (1580s). This play established the fashion for tragedy in the theatre. It moved freely in place and time, as did medieval drama. But *The Spanish Tragedy* also showed the influence of Seneca in its use of a ghost, the revenge theme, the chorus, the lofty poetic style, and the division of the play into five acts. Most of all, Kyd demonstrated how to construct a clear, absorbing story. He wrote *The Spanish Tragedy* in blank verse and established this poetic form as the style for English tragedy (see **Blank verse**). *The Spanish Tragedy* may seem crude today. However, the play was a remarkable advance over earlier drama and had great influence on later drama.





**Masques** were elaborate, colourful spectacles that combined music, dancing, vivid costumes, and symbolic drama. English masques were popular with royalty and nobility.

Christopher Marlowe perfected blank verse in English tragedy. Marlowe wrote a series of tragedies that centred on a strong *protagonist* (main character). Marlowe's work was filled with sensationalism and cruelty, but it included splendid poetry and scenes of sweeping passion.

John Lyly wrote primarily for companies of boy actors that specialized in performing before aristocratic audiences. Most of Lyly's plays were pastoral comedies. He mixed classical mythology with English subjects, and wrote in a refined, artificial style.

Robert Greene also wrote pastoral and romantic comedies. His *Friar Bacon and Friar Bungay* (about 1589) and *James IV* (about 1591) combined love stories and rural adventures with historical incidents. Greene's heroines are noted for their cleverness and charm.

Thus, by 1590, several dramatists had bridged the gap between the learned and popular audiences. Their blending of classical and medieval devices with absorbing stories established the foundations upon which Shakespeare built. William Shakespeare, like other writers of his time, borrowed from fiction, histories, myths, and earlier plays. Shakespeare contributed little that was entirely new, but he developed the dramatic techniques of earlier playwrights. His dramatic poetry is unequalled, and he had a genius for probing character, producing emotion, and relating human experience to broad philosophical issues.

Ben Jonson's comedies are sometimes called *corrective* because he tried to improve human behaviour by ridiculing foolishness and vice. He popularized the *comedy of humours*. According to a Renaissance medical concept, everyone had four *humours* (fluids) in his or her body. Good health depended on a proper balance among them. An excess of one humour might dominate a person's disposition. An excess of bile, for example, supposedly made a person melancholy. Jonson also wrote two tragedies on classical subjects, and many elaborate spectacles called *masques*.

Several other playwrights bridged the Elizabethan and Jacobean periods besides Shakespeare and Jonson. They included George Chapman, Thomas Dekker, Thomas Heywood, and John Marston.

**Jacobean and Caroline drama.** About 1610, English drama began to change significantly. The *tragicomedy*, a serious play with a happy ending, increased in popularity. Many plots were artificially arranged and contained sensational, rather than genuinely tragic, elements. The obsession of much Jacobean and Caroline tragedy with violence, dishonesty, and horror has appalled many critics. But these plays have also been greatly admired for their magnificent poetry, their dramatic power, and their unflinching view of human nature and the human condition.

Important Jacobean playwrights included Francis Beaumont, John Fletcher, Thomas Middleton, Cyril Tourneur, and John Webster. Philip Massinger and John Ford were among the important Caroline playwrights.

After Charles I was deposed in the 1640's and the Puritans gained control of Parliament, theatrical performances were prohibited. The Puritan government closed the theatres in 1642, ending the richest and most varied era of English drama.

## *The Golden Age of Spanish drama*

The late 1500's brought a burst of theatrical activity in Spain as well as in England. The period between the mid-1500's and late 1600's was so productive that it is called the Golden Age of Spanish drama.

During the Middle Ages, religious drama developed only in northeastern Spain. The rest of the country was occupied by the Moors. After the Moors were driven from the country in the late 1400's, Spanish rulers began

to re-introduce Christianity into the country. Drama became an important means of religious teaching. Religious drama, perhaps because of church control, grew in importance in Spain while being banned in other countries during the Reformation. Until the 1550's, Spanish religious plays resembled those of other European nations. After 1550, the religious plays of Spain assumed various traits of their own.



**Religious plays** in Spain were called *autos sacramentales*. They combined features of the cycle play and the morality play. Human and supernatural characters were mingled with such symbolic figures as Sin, Grace, and Pleasure. Dramatists took stories from secular as well as religious sources, and adapted them to uphold church teachings. In Madrid, trade guilds staged the plays until the city council took over the job in the 1550's. The council engaged Spain's finest dramatists to write plays and hired professional companies to perform them. The public and religious stages closely resembled each other after 1550, and the same dramatists wrote for both.

Production of the plays varied from community to community, but the staging in Madrid was typical. The *autos sacramentales* were performed on *carros* (two-storied wagons) that resembled the pageant wagons of the English cycle plays. *Carros* carrying scenery were drawn through the streets to various points where audiences gathered. A second wagon served as a stage when placed in front of the *carro*. The second wagons eventually became permanent acting areas at various places, and the *carros* were drawn up to them. The *autos* were performed by professionals, but they retained their religious content and their close association with the church. They were performed annually during the Feast of Corpus Christi.

In addition to the *autos*, the actors performed short farces in the form of interludes and dances. These grew in importance, and gradually the secular elements began to dominate the performances. In 1765, church authorities forbade *autos* because of their content and the carnival spirit of farce and dancing.

**Secular drama.** The first permanent theatre in Spain opened in Madrid in 1579. Spanish theatres generally resembled Elizabethan theatres in design.

Lope de Rueda, a dramatist, actor, and producer, established the professional theatre in Spain during the mid-1500's. However, the professional Spanish theatre actually did not flourish until after 1580. The two greatest playwrights of the Golden Age of Spanish drama



*Carros*, the Spanish travelling stages, brought religious drama to town audiences during the annual Feast of Corpus Christi.

were Lope de Vega and Pedro Calderón de la Barca.

Lope de Vega may have written as many as 1,800 plays. More than 400 surviving plays are attributed to him. Lope took subjects for his plays from the Bible, the lives of the saints, mythology, history, romances, and other sources. He was inventive and skilful, but his plays lack the depth of Shakespeare's. Like Shakespeare, he often used song and dance and mixed the comic with the serious. Lope influenced almost all future Spanish drama.

Calderón wrote many kinds of plays, but is best known for works exploring religious and philosophical ideas. Most of his works were *autos* written for the Corpus Christi festivals of Madrid. After Calderón's death in 1681, Spanish drama declined rapidly and never fully recovered its early vitality.

## French neoclassical drama

**The French theatre** had its roots in the medieval religious plays produced by guilds. The most important of these amateur groups, the *Confrérie de la Passion*, established a permanent theatre in Paris in the early 1400's. It eventually received a royal monopoly, making it the city's only play-producing organization.

During the late 1500's and 1600's, the *Confrérie's* theatre, called the *Hôtel de Bourgogne*, was rented to visiting professional companies. The first of these groups to establish itself was *Les Comédiens du Roi*, sometime after 1598. Alexandre Hardy, the most popular dramatist of the early 1600's, wrote many plays for this company. Hardy mostly wrote loosely constructed tragicomedies filled with adventures of chivalry.

The French theatre changed significantly after the neoclassic theories were imported from Italy. In France, these theories took firmer root and were followed more rigidly than elsewhere. The basic beliefs of neoclassicism can be summarized in four parts. (1) Only two types

of drama, tragedy and comedy, were legitimate forms, and tragic and comic elements should not be mixed. (2) Drama should be written to teach a moral lesson by presenting the lesson in a pleasant form. (3) Characters should be universal types rather than eccentric individuals. This principle became known as the doctrine of *decorum*. (4) The unities of time, place, and action should be observed. This rule usually meant that a plot should cover no more than 24 hours, take place in a single locality, and deal with a single action.

**Neoclassical playwrights.** Although neoclassical ideas were accepted among educated French people in the late 1500's, they made little impression in public theatres until the 1630's. The playwright most closely associated with the change to neoclassic drama in France was Pierre Corneille. His play *The Cid* set off a stormy dispute that ended with the triumph of neoclassicism. *The Cid* is a tragicomedy based on a Spanish story. It follows many neoclassical rules, but violates the doctrine



of decorum because the heroine marries her father's murderer. In later plays, Corneille observed the neoclassic rules and helped establish neoclassicism as the standard for French drama. The distinguishing characteristic of Corneille's drama is the hero of unyielding will. The hero gains steadily in power, but his character does not become more complex. Corneille wrote in a form of verse called Alexandrine, which became standard for French neoclassic drama.

The plays of Jean Racine marked the peak of French neoclassic tragedy. His first dramas in the 1660's established his reputation, and he soon surpassed Corneille. Racine used neoclassical rules to concentrate and intensify the dramatic power of his stories. His tragedies contained little outward action. Their drama came from internal conflicts centring on a single fully developed personality. This character usually wants to act ethically, but is prevented by other forces—often by conflicting

desires. Racine created simple plots, but he revealed his characters with remarkable truth.

Molière raised French comedy to a level comparable with that of French tragedy. He also was the finest comic actor of his age, and a theatre manager and a director. Molière borrowed freely from many sources, including Roman comedy, medieval farce, and Spanish and Italian stories. His most famous plays were comedies that centred around such humorous eccentrics as misers. The ridiculous excesses of the protagonists were exposed by characters of "good sense." Molière's comedies offered much biting social and moral criticism, but were amusing and good-natured. He has achieved wider and more lasting appeal than Corneille or Racine.

By about 1690, the three major French dramatists were either dead or had given up writing. Most of their successors merely repeated the old formulas, and French drama declined.

### European drama: 1660-1800

**England.** In 1660, the Restoration ended the Puritan government. Charles II returned to the throne. Once again the theatre became legal in England. But the English theatre had lost the broad popular appeal it had enjoyed in Shakespeare's day. It became the pastime of a narrow circle of courtiers. Only gradually did it again become popular with the middle classes.

Soon after the theatres reopened in 1660, new playhouses in the Italian style were built in London. These theatres had a large *apron* (the part of the stage in front of the proscenium arch). Permanent doors opened onto the apron. The auditorium had tiered galleries with some private boxes. Cheaper seats were in a roughly U-shaped flat area called the *pit*. Until 1762, spectators often sat on the stage itself.

Settings in the English theatre closely resembled those used in Italy, with scenes painted in perspective. Because of the neoclassic demand for universal themes, most settings were generalized—a palace or a garden, for example. During the later 1700's, settings began to show specific places.

Actresses first appeared regularly on the English stage in the 1660's, and male actors soon stopped playing women's roles. Actors became increasingly important during the 1700's, and audiences often went to see outstanding performers rather than a particular play. Actors apparently based their style on real life, but their acting was undoubtedly more exaggerated than would appeal to today's audiences. In the 1740's, David Garrick brought greater realism to English acting.

The Restoration period is known especially for the *comedy of manners* and the *heroic drama*. The comedy of manners was the form most identified with the Restoration. It *satirized* (poked fun at) upper-class society in witty prose. Some of these satires tolerated immorality, but the ideal behind them was self-knowledge. Characters in the comedy of manners were ridiculed for deceiving themselves or trying to deceive others. The most common characters included the old woman trying to appear young, and the jealous old man married to a young wife. The ideal characters were worldly, intelligent, and undeceived.

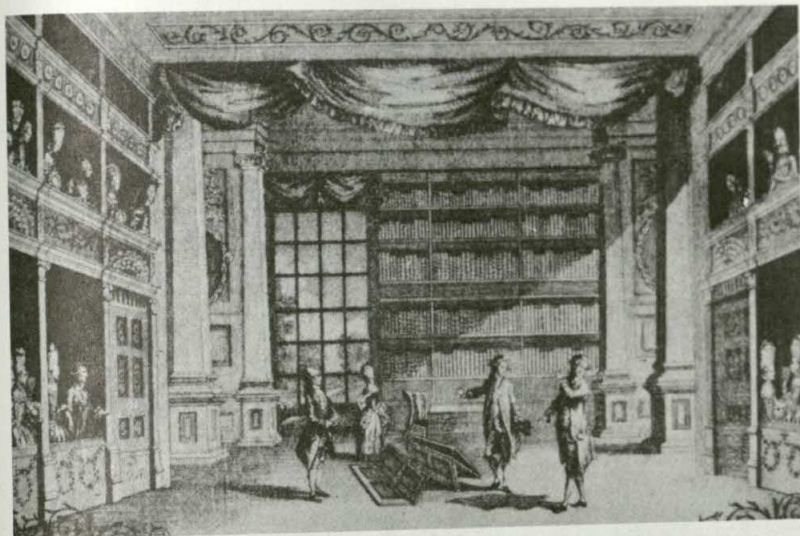
The comedy of manners originated largely in the plays of George Etherege. The form was perfected in the dramas of William Congreve, whose *The Way of the World* (1700) is often called the finest example of the form. In the works of William Wycherley, the tone was coarser and the humour more robust.

English comedy enjoyed a period of extreme liberty during the reign of Charles II. But Puritan elements reappeared in the early 1700's as the merchant class grew more powerful. Middle-class disapproval of the comic tone was reflected in the change from the mocking Restoration plays to the more sentimental comedies of



David Garrick was the leading English actor of his day. Garrick's realistic style of acting had a great influence on the English theatre.





*The School for Scandal* by Richard Brinsley Sheridan is one of the greatest English comedies of the 1700's. This print shows a scene from the play at the famous Drury Lane Theatre in London in 1778.

George Farquhar. Farquhar put emphasis on emotion and good-hearted behaviour.

The heroic play flourished from about 1660 to 1680. It was written in rhymed couplets and dealt with the conflict between love and honour. These plays featured elaborate rhetoric, many shifts in plot, and violent action. Such dramas seem absurd today, but they were popular in their time.

A more vital strain of tragedy developed alongside heroic drama. These tragedies were written in blank verse that imitated Shakespeare's. Notable examples were John Dryden's *All for Love* (1677), which reshaped the story of Antony and Cleopatra according to neoclassical rules, and Thomas Otway's *Venice Preserv'd* (1682).

The term *sentimental* is often applied to most drama of the 1700's. It indicates an overemphasis on arousing sympathy for the misfortunes of others. Plots dealt with the ordeals of characters with whom the audience sympathized. The humorous portions of plays featured such minor characters as servants. Today, the characters seem too noble and the situations too artificial to be convincing. But audiences of the 1700's liked them, believing that emotional displays were spiritually uplifting.

Sentimental comedy had its first full expression in *The Conscious Lovers* (1722) by Sir Richard Steele. In the 1770's, when this type of comedy dominated the English stage, two dramatists tried to reform public taste with comedies that avoided excessive sentimentality. Oliver Goldsmith attempted to reestablish what he called *laughing comedy* in the tradition of Ben Jonson. Richard Brinsley Sheridan's plays have the satire of Restoration comedy, but lack its questionable moral tone.

*Domestic tragedy* substituted middle-class characters for the kings and nobles of earlier tragedy. It is an ancestor of serious drama. Domestic tragedy showed the horrifying results of yielding to sin, while sentimental comedy showed the rewards of resisting sin. George Lillo's *The London Merchant* (1731) popularized domestic tragedy. This drama became a model for playwrights in France and Germany as well as England.

Several minor dramatic forms also developed. The *ballad opera* was a prose comedy with lyrics sung to popular tunes. The most famous one was John Gay's *The Beggar's Opera* (1728). The *burlesque* was a parody of well-known dramas or literary practices. The *pantomime* combined dance, music, acting without dialogue, and elaborate scenery and special effects.

**France.** By the end of the 1600's, France had become the cultural centre of Europe. The standard for European drama was set by the neoclassic tragedies of Corneille and Racine and the comedies of Molière. The effort to obey the rules of neoclassicism tended to freeze dramatic invention during the 1700's. Voltaire was the only notable French tragic dramatist. The first important French writer of domestic tragedy was Denis Diderot. His plays enjoyed little popularity during his lifetime. However, his proposed reforms in staging, acting, and playwriting—all designed for greater realism—greatly influenced dramatists of the 1800's.

For most of the 1700's, the French government permitted only one theatrical company, the Comédie-Française, to produce regular comedy and tragedy. Minor forms, including comic opera, short plays, and burlesques, were staged by the Comédie-Italienne, an Italian group, and at Paris fairs.

Pierre Marivaux wrote comedies in a sophisticated style that had some sentimental touches but were primarily revelations of human psychology. Sentimental comedy appeared in the works of Pierre de La Chaussée. His play *The False Antipathy* (1733) established the popularity of *comédie larmoyante* (tearful comedy). True comedy in the form of brilliant social satire appeared in the plays of Pierre Beaumarchais.

**Italy.** During the 1700's, Italian dramatists worked to preserve *commedia dell'arte* by incorporating its characters into written plays. Carlo Goldoni was the greatest Italian dramatist of the period. He wrote sentimental versions of *commedia*, as well as many excellent comedies. Carlo Gozzi opposed Goldoni's changes in *commedia*, and attempted reforms of his own by writing *imagina-*



tive fantasies with some improvised scenes. In spite of the efforts of Goldoni and Gozzi, *commedia dell'arte* declined in popularity. By the end of the 1700's, it was no longer a significant form. The only important Italian tragic dramatist was Vittorio Alfieri.

**Germany.** A crude type of drama developed in various German states during the 1500's and 1600's. German theatre had a low reputation until about 1725. At that time, the actress-manager Caroline Neuber and the dramatist Johann Gottsched made serious efforts to reform both playwriting and play production. Their work

marked a turning point in German theatre.

The dramatist and critic Gotthold Ephraim Lessing also made important contributions. His plays and his influential critical work *The Hamburg Dramaturgy* turned attention from French neoclassicism to English dramatic models. By the end of the 1700's, the German theatre had been revolutionized. All major German states supported theatres modelled on the Comédie-Française, and German playwrights won recognition outside Germany. The neoclassical ideal was giving way to the romantic movement.

## Asian drama

Drama in Asia developed independently of European drama. Not until the 1800's did Western playwrights generally become aware of Oriental drama and begin to borrow from its rich heritage.

**India.** Indian drama is one of the oldest in the world. Its exact origins are uncertain, but sometime between 200 B.C. and A.D. 200, the wise man Bharata wrote the *Natyasastra*, an essay which established traditions of dance, drama, makeup, costume, and acting.

By the mid-A.D. 300's, flourishing drama in the Sanskrit language had developed. In technique, Sanskrit plays resembled epic poems. Each play was organized around one of nine *rasas* (moods). The goal was to produce harmony, so authors avoided clashing moods and all plays ended happily. The most important of the surviving plays are *The Little Clay Cart* (probably A.D. 300's) and *Shakuntala* by Kalidasa (late 300's or early 400's).

**China.** The drama of China probably originated in ancient ceremonies performed in song, dance, and mime by priests at Buddhist shrines. Professional storytellers became common by the A.D. 700's, but not until the 1200's did performances become truly dramatic.

The first formal Chinese drama appeared during the Yuan dynasty (1279-1368). Since the 1800's, *Peking opera*

(also called *Beijing opera*) has been the major form. The plays of the Peking opera are based on traditional stories, history, mythology, folklore, and popular romances. The play is merely an outline for a performance. Performers often make changes in the script.

The Chinese stage is simple, permitting rapid changes of location. These changes are indicated by speech, actions, or symbolic props. A whip, for example, indicates that a performer is on horseback. Musicians, and assistants who help the performers with their costumes and props, remain on stage during the performance. But by tradition they are considered invisible. The performer is the heart of Chinese theatre. Richly and colourfully costumed, the performer moves, sings, and speaks according to rigid conventions. Each type of role has a definite vocal tone and pitch, and delivery follows fixed rhythmic patterns.

**Japan.** The *no* plays are the oldest of the three traditional forms of Japanese drama. They developed during the 1300's from dances performed at religious shrines. The *no* theatre reached its present form in the 1600's, and it has remained practically unchanged since then.

No plays are poetic treatments of history and legend, influenced by the religious beliefs of Buddhism and



**Indian and Chinese drama** emphasize national legends, myths, and history. Indian folk theatre, *left*, dramatizes stories from Indian epics and sacred Hindu writings. Peking opera, *right*, is the leading dramatic tradition of China. Peking opera is noted for its richly costumed performers.





**Japanese kabuki plays**, above, are violent and melodramatic. These plays, traditionally performed by male casts, dramatize historical or domestic events.

Shintoism. Many of these plays are shorter than Western one-act plays, and they may seem undramatic. Like ancient Greek tragedy, a no drama is accompanied by music, dance, and choral speaking, and the actors playing women and demons wear masks. The no performance is probably the most carefully controlled in the world. Every detail of the traditional stage, every movement of the hands and feet, every vocal intonation, and every detail of costume and makeup follows a rule.

Japanese *doll* or *puppet* theatre enjoyed great popularity in the 1600's and 1700's. Today, only one theatrical company performs these plays. Like the no plays, the puppet dramas originally were religious. The puppets stand 1 to 1.5 metres high and look realistic, with flexible joints and movable eyes, mouth, and eyebrows. The puppet handlers work quietly on the stage in view of the audience. A narrator recites the story to music and ex-

presses each puppet's emotions.

The *kabuki* play is the most popular traditional form in Japan today, and the most sensitive to changing times. It is also the least pure of the three traditional forms, having borrowed freely from other types of theatre. Kabuki, the last of the forms to develop, appeared about 1600. It competed with the puppet theatre for popularity during the late 1700's and also took over many puppet theatre plays and techniques.

The earliest kabuki were performed by a single female dancer. An all-male cast later became traditional. Although kabuki borrowed much from the no drama, it differs greatly from the formality of the no plays. Kabuki theatre is violently melodramatic. It features colourful costumes and makeup, spectacular scenery, and a lively and exaggerated acting style. See *Japan* (The arts [Theatre; picture]).

## Romanticism

Many elements made up romanticism, a European literary movement of the late 1700's and early 1800's. The most important was a growing distrust of reason and a new belief that people should be guided by their feelings and emotions. The romantics tended to rebel against traditional social and political institutions. Romantic playwrights rebelled against the rules of neoclassical tragedy, taking Shakespeare as their model. Variety and richness became the standard for judging drama, replacing the unity and simplicity admired by the classicists. See **Romanticism**.

By 1800, a productive romantic movement had become established in Germany. Two important dramatists of the period, Johann Wolfgang von Goethe and Friedrich Schiller, wrote plays in the romantic style, but both denied being romantics. In many ways, Goethe's *Faust* showed the romantic outlook in the protagonist's

unending search for fulfilment. Many of Schiller's plays dramatized moments of crisis in history.

After Germany's defeat by Napoleon's armies in 1806, some Germans became increasingly interested in their national past and less hopeful about human nature. This sceptical attitude appeared in the work of two of the best German dramatists of the day, Heinrich von Kleist and Georg Büchner.

The intentions of French romantics were clearly established with the publication of Victor Hugo's preface to his play *Cromwell* in 1827. Romanticism triumphed in the French theatre with the production of Hugo's *Hernani* in 1830. *Hernani* revolved around the conflict between love and honour, and was filled with exciting episodes, suspense, and powerful verse. French romantic plays were less philosophical than German romantic plays. In addition, they depended more on such devices



as disguises and narrow escapes. Probably the most outstanding French romantic dramatist was Alfred de Musset, who explored the psychological motives of his protagonists.

Melodrama appeared along with romantic drama at the beginning of the 1800's. It helped stimulate the de-

velopment of realistic scenery. Many melodramatic scenes of breathtaking escapes and such natural disasters as floods required clever, detailed settings. Melodrama appealed to a much wider audience than romantic drama, and remained popular long after the romantic movement had ended.

### Early realism

By the mid-1800's, Europe was being transformed by the development of an industrial society creating new and complex social conditions. Many people believed these conditions should be studied to determine their effect on human behaviour. They also felt that literature should reflect real life. As these attitudes spread throughout literature and the theatre, they were reflected in the style known as realism. Realistic playwrights tried to portray the real world, which they studied by direct observation. These playwrights found their subjects in daily life and wrote dialogue in conversational prose. See **Realism**.

The popularity of melodrama stimulated the development of realistic settings and elaborate special effects. The development of the *box set* was an important step toward stage realism in the 1800's. Scenery enclosed the acting area at the back and sides, imitating the shape of a room with one wall removed. Actors tried to create the illusion of real people in a real room.

Realism was soon followed by *naturalism*, a more extreme but less influential movement. The naturalists believed that drama should become scientific in its methods. They argued that drama should either demonstrate scientific laws of human behaviour or record case histories. Naturalists also placed greater emphasis on heredity and environment in determining behaviour. Naturalism as a self-conscious movement declined after 1900, but by emphasizing the need for copying the details of

daily life, it strengthened the realist movement. See **Naturalism**.

Directors appeared in the late 1800's, partly as a result of the growing complexity in staging. In earlier periods, a leading actor took the responsibility of staging most plays. As the demand for greater realism increased, so did the need for more careful rehearsals and better coordination of all elements. The history of the modern director is usually traced from the work of Georg II, Duke of Saxe-Meiningen. His well-rehearsed German acting company toured Europe between 1874 and 1890. This group demonstrated the value of integrating all aspects of a theatrical production into an artistic whole.

The independent theatre movement developed in most European countries because commercial theatres refused to present realistic drama. Commercial theatre managers feared the controversy it aroused, leading to the possibility of government opposition. Independent theatres began to appear in the 1880's. They were private organizations open only to members and could perform works that otherwise would not have been presented. The first important independent theatre was the Théâtre Libre, founded in Paris in 1887 by André Antoine. The Freie Bühne was established in Berlin by Otto Brahm in 1889. The Independent Theatre Society, founded by Jacob T. Grein in London in 1891, introduced the witty plays of George Bernard Shaw to audiences in England.

### Modern drama: Ibsen to World War II

**Ibsen.** The strongest influence in the development of realistic drama came from Henrik Ibsen, Norway's first important dramatist. Ibsen is often called the founder of modern drama. His plays were both the high point of realism and the forerunner of movements away from realism. Ibsen broke with tradition not only in technique but also in his fearless treatment of human problems. He portrayed the environment in his plays realistically. His characters reveal themselves as they would in real life—through their words and actions rather than by a statement by the author.

Ibsen's *The League of Youth* (1869) was the first of a series of plays that handled social problems realistically, though his realistic plays contain important elements of symbolism as well. *A Doll's House* (1879) and *Ghosts* (1882) were explosive attacks against the conventional morality of Ibsen's time. In *Hedda Gabler* (1891) and *The Master Builder* (1893), Ibsen intensified his focus on the mind and spirit of the individual. In his late plays, especially in *When We Dead Awaken* (1900), Ibsen increased his emphasis on symbols and mysterious forces beyond human control.

**Russian drama and Chekhov.** The realistic plays of the Russian writer Anton Chekhov became nearly as influential as those of Ibsen. The principal playwrights in Russia before Chekhov included Nikolai Gogol, Alexander Ostrovsky, and Ivan Turgenev. Gogol's farce *The Inspector-General* (1836) satirized small-town officials. Ostrovsky portrayed the everyday life of the merchant class in such plays as *The Storm* (1860). Turgenev's play *A Month in the Country* (completed in 1850) was a realistic study of boredom, jealousy, and compromise, elements that appear in Chekhov's plays.

Chekhov took his subjects from Russian society of his day. He skilfully created action that reflects the apparent aimlessness of life itself. As in life, comic incidents often intermingle with pathetic or tragic ones. Chekhov's greatest masterpieces are his last four plays—*The Seagull* (1896), *Uncle Vanya* (1898), *The Three Sisters* (1901), and *The Cherry Orchard* (1904).

**English drama.** The realistic spirit gradually influenced dramatists throughout Europe. Until the last quarter of the 1800's, the British theatre was dominated by sentimental romances and melodrama. Henry Arthur





**Expressionism** distorts the outside world to reveal the tortured minds of the characters in the grip of fear or other violent emotions. This scene is from *The Adding Machine* by Elmer Rice.

Jones and Arthur Wing Pinero, the most popular British dramatists of the late 1800's, moved toward realism.

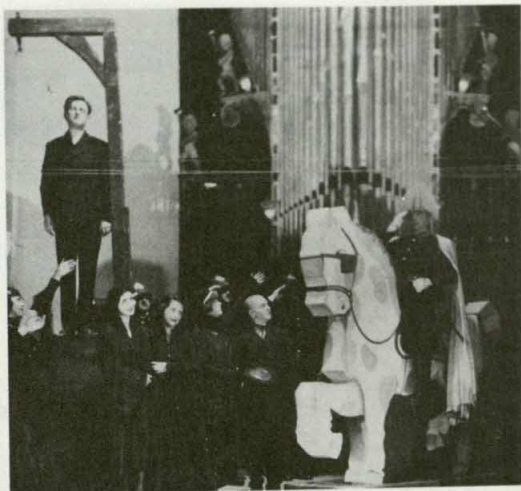
The plays of Sir James M. Barrie have some realism, but they are basically romantic and many are overly sentimental. Oscar Wilde is remembered chiefly for his brilliant comedy *The Importance of Being Earnest* (1895). Novelist John Galsworthy wrote powerful realistic plays, including *Strife* (1909), a drama about labour strikes.

George Bernard Shaw was an influential critic as well as dramatist. He supported the social and artistic ideals of Ibsen, and was chiefly responsible for their spread in England. Most of Shaw's plays are examples of the comedy of ideas, in which the theatre is used as a forum for social, political, and moral criticism.

**Irish drama.** A remarkable period of theatrical activity developed in Ireland during the late 1800's and extended into the 1900's. It was part of a general nationalistic revival of Irish literature known as the Irish Literary Revival. Irish drama centred on the Abbey Theatre in Dublin. It staged the plays of most major Irish dramatists, including Lady Gregory, Sean O'Casey, John Millington Synge, and William Butler Yeats.

**French drama.** Jean Giraudoux was probably the leading French playwright between World War I and World War II. He often used Greek myths, Biblical stories, and fantasy to make sympathetic and witty comments about humanity. Jean Cocteau also used Greek myths as the basis of his plays, but he was much more experimental in his style. Paul Claudel became famous for his religious verse plays. Jean Anouilh's many plays vary in form, but they usually take the side of youthful purity against the corrupting forces of age and greed.

**United States drama.** Until the early 1900's, American drama closely followed the European theatre. Few American dramatists of distinction appeared until the 1800's, and none gained international recognition until Eugene O'Neill, who began writing in 1913. O'Neill's plays are a record of persistent experimentation with various styles and dramatic devices. His power is proba-



**Epic theatre** largely consists of the work of a single playwright, Bertolt Brecht of Germany. Brecht's most popular work is the satirical musical drama *The Threepenny Opera* (1928).

bly best revealed in his drama of tortured family relationships, *Long Day's Journey into Night*.

Other significant American dramatists of the 1920's and 1930's were Lillian Hellman; Clifford Odets, whose best plays express the political and social radicalism of the Great Depression years; Elmer Rice; and Thornton Wilder. Popular comic playwrights included the team of George S. Kaufman and Moss Hart. In this period, American musical comedy developed into an art form capable of a wide range of expression. Much of its appeal resulted from the music of composers George Gershwin, Jerome Kern, Cole Porter, and Richard Rodgers.

**Italian drama.** Since the late 1700's, few important Italian dramatists have appeared. A noteworthy exception is Luigi Pirandello, the leading Italian playwright of the 1900's. His plays are based on the idea that there is no single truth—only the conflicting views of individuals. Another dramatist, Ugo Betti, became famous for his tragedies about guilt and justice.

**Symbolism** in drama developed in France during the 1880's. The symbolists believed that appearance is only a minor aspect of reality. They believed that reality could be found in mysterious, unknowable forces that control human destiny. They argued that truth could not be portrayed by logical thought, but could only be suggested by symbols. Their plays tended to be vague and puzzling. The settings and the performers' movements and speaking style were deliberately unrealistic in an attempt to stimulate the audience to look for deeper meanings in the action. The most celebrated symbolist dramatist was Maurice Maeterlinck.

**Expressionism** is difficult to define because the term was used in Germany between 1910 and 1925 to describe almost any departure from realism. Most German expressionists believed that the human spirit was the basic shaper of reality. Surface appearance, therefore, was important only as it reflected an inner vision. To portray this view, expressionist playwrights used distorted sets, lighting, and costumes; short, jerky



speeches; and machinelike movements. Expressionistic techniques can be seen in Georg Kaiser's *From Morn to Midnight* (1916), a symbolic story of humanity's misguided search for happiness through wealth.

Expressionism appeared in Germany about 1910. The dramatic techniques of expressionism owed much to the Swedish dramatist August Strindberg. In such plays as *To Damascus* (parts I and II written in 1898, part III written in 1901), *A Dream Play* (written in 1901), and *The Ghost Sonata* (1908), time and place shift freely. Characters multiply and merge and objects change in appearance. See **Expressionism**.

**Epic theatre.** The discontent of the post-World War I era appeared in much drama of the 1920's and 1930's.

## Modern drama since World War II

Many countries were dramatically changed during World War II (1939-1945) and the years which followed, and these changes affected drama greatly. Experimental and alternative theatre developed new structures for drama, challenging traditions in dramatic form and in social values. Live theatre increasingly had to compete with drama in film, radio, and television. In some countries, such as India, competition from local film drama led to the closure of many live theatres. In other countries, such as Britain, television drama developed as a distinct form contrasting with live theatre.

**Theatre of the absurd**, which emerged in France during the 1950's, was probably the most influential new movement in drama after the end of World War II in 1945. The absurdists rejected conventional notions of plot, character, dialogue, and logic in favour of dreamlike metaphors that did not try to imitate surface reality. They hoped to express the disorientation of living in a universe they saw as unfriendly, irrational, and meaningless, and therefore absurd.

The most famous play of the theatre of the absurd was *Waiting for Godot* (1953) by Samuel Beckett. In this work, two tramps pass the time uncomfortably while waiting for someone named Godot, who never arrives. The plays of Eugène Ionesco, particularly *The Bald Soprano* (1953), also violated conventional dramatic form.



**Theatre of the absurd** was a broad movement that included many important new playwrights of the 1950's. Samuel Beckett wrote about characters, such as the two tramps in this scene from *Waiting for Godot*, who lead meaningless lives.

The most fruitful attempt to focus the attention of theatregoers on political, economic, and social realities was epic theatre, developed by the German dramatist Bertolt Brecht.

Brecht adopted the name *epic* to distinguish his aims from those of the traditional *dramatic* theatre. He used techniques of the epic poem, including episodic action and narrative mixed with dialogue. In such plays as *Mother Courage and Her Children* (1941) and *Life of Galileo* (1943), Brecht tried to make spectators think critically and relate his plays to real-life conditions. In this way, he hoped to inspire them to change those conditions. Brecht wrote all his major works before 1945, but his greatest influence came later.

Jean Genet portrayed human behaviour as a series of ceremonies expressing sexual and political desires for violence and domination.

**Experimental theatre.** Many theatre artists were influenced by the writings of French director and dramatist Antonin Artaud. He demanded an intense, rigorous theatre free from the domination of playwrights.

Americans Julian Beck and Judith Malina established the Living Theater in 1951. The Living Theater worked to abolish the conventional boundaries between theatre and politics, between actors and spectators, and between stage and auditorium. Joseph Chaikin, a former Living Theater actor, later founded the Open Theater in New York City. It staged such works as *The Serpent* (1968), with a text by American dramatist Jean-Claude van Itallie. The productions and writings of the Polish director Jerzy Grotowski also influenced experimental theatre. In the 1970's, experimental theatre lost much of its crusading energy and determination to change the world.

Alternative theatre originated in many countries as a form of political protest during the 1960's. In Britain, the fringe movement grew out of the Edinburgh Festival, and became a major dramatic movement. Fringe drama, which included much political satire, was widely performed in small theatres.

**Later German-language drama** reflects the influence of both epic and absurdist theatre. Swiss dramatist Friedrich Dürrenmatt's *The Visit* (1956) and *The Physicists* (1962) are dark parables about crime, guilt, responsibility, and justice. German playwright Peter Weiss's powerful *Marat/Sade* (1964) features an anguished reconsideration of the French Revolution (1789-1799) by inmates of a mental institution. Austrian dramatist Peter Handke and German playwright Heiner Müller wrote plays in the absurdist tradition. German dramatist Franz Xaver Kroetz wrote harsh, naturalistic plays of stinging social criticism.

**Television drama.** The nature of a television audience, with people relaxed at home, encourages a particularly intimate form of drama. The 1940's and 1950's is considered a golden age of television drama in the United States. American writers, such as Paddy Chayefsky, depicted ordinary events in television drama. In Britain, Jeremy Sandford's *Cathy Come Home* (1966) firmly established documentary drama on television.



Television drama includes series and single plays. British writers who have been outstanding in both forms include Dennis Potter and John Mortimer. Potter's drama has been particularly innovative, bringing in ideas such as casting adults as children, or including recordings of popular songs.

**Later British drama.** In England after World War II (1939-1945), interest in verse drama was revived briefly by T. S. Eliot and Christopher Fry. A new period in English drama began with John Osborne's *Look Back in Anger* (1956). This realistic play gave a voice to the rebellious spirit of a group of writers eventually called the "angry young men." Along with the plays of Brecht and Beckett, *Look Back in Anger* stimulated a new generation of English playwrights.

Harold Pinter is Beckett's most important follower. Pinter's plays create a menacing atmosphere from everyday events and seemingly realistic dialogue. John Arden, Edward Bond, Howard Brenton, Caryl Churchill, David Hare, and Arnold Wesker wrote specifically as political radicals. Tom Stoppard attacked political radicals in his plays. Despite their differences, all of these dramatists expressed discontent with the quality of life in modern Britain.

One of the most commercially successful later British playwrights is Alan Ayckbourn. Many of his plays are about middle-class values, using dramatic conventions from farce. Michael Frayn's plays are also often comic, exploring people's behaviour in relation to various institutions. Peter Nichols produced original and unsettling comedies, experimenting with popular forms such as pantomime and musicals.

Joe Orton's black comedies shocked audiences by dealing with taboo subjects as if they were everyday events. Peter Shaffer's tragedies, such as *Amadeus* (1979), often focus on the tension between the intellect and passionate emotion. Other modern British dramatists include Simon Gray, Alan Bennett, Trevor Griffiths, and the comedy-writers Willy Russell and Keith Waterhouse. New women dramatists include Clare McIntyre, Sarah Daniels, and Lucy Gannon.

**Later United States drama.** Tennessee Williams and Arthur Miller became the leading American dramatists of the 1940's and 1950's. Both playwrights combined realistic dialogue with expressionistic staging. In such plays as *The Glass Menagerie* (1945) and *A Streetcar Named Desire* (1947), Williams wrote of faded Southern belles who were not equipped to function in the turbulent United States of the 1900's. In *Death of a Salesman* (1949), Miller used a common man's personal failure to criticize society's focus on material success. The play received considerable critical acclaim and won him the Pulitzer Prize.

In the 1950's, small theatres sprang up in several neighbourhoods of Manhattan in New York City. These theatres became known as *off-Broadway*. They introduced many American playwrights, notably Edward Albee's successful play *Who's Afraid of Virginia Woolf?* (1962), a wry, grim drama of domestic discord, was first produced on Broadway in 1962.

In the 1960's, new voices in the American theatre expressed various ethnic, sexual, political, and aesthetic concerns. A typical play of this time was the black dramatist Lorraine Hansberry's *A Raisin in the Sun* (1959).



The plays of British playwright Harold Pinter frequently express a sense of menace. In *The Homecoming* (above), Pinter uses this effect to explore power structures within the family.

During the late 1900's, noncommercial theatres took up the presentation of new plays. For example, Sam Shepard's hallucinatory family play *Buried Child* (1978) was first presented at the Magic Theater in San Francisco. August Wilson became the leading black American dramatist of the 1980's.

**Drama in other countries** often expresses anger at political and social injustice. South African dramatist Athol Fugard writes sombre, realistic plays about *apartheid* (South Africa's policy of racial segregation). Dario Fo of Italy writes broadly comic but pointedly satiric plays. Czechoslovakian dramatist Václav Havel explores the breakdown of communication. The plays of Wole Soyinka of Nigeria reveal his belief in the importance of individual freedom.

**Related articles.** See Theatre and its list of *Related articles*. See also such literature articles as *American literature* and the following articles:

#### American playwrights

Albee, Edward  
Anderson, Maxwell  
Baraka, Amiri  
Barry, Philip  
Behrman, S. N.  
Cohan, George M.

Dunlap, William  
Hart, Moss  
Hecht, Ben  
Hellman, Lillian  
Inge, William



Kaufman, George S.  
Kingsley, Sidney  
Lindsay, Howard  
Luce, Clare Boothe  
Mamet, David  
McCullers, Carson  
Miller, Arthur  
Odets, Clifford  
O'Neill, Eugene G.  
Payne, John Howard

Rice, Elmer  
Saroyan, William  
Shaw, Irwin  
Shepard, Sam  
Sherwood, Robert E.  
Simon, Neil  
Van Druten, John W.  
Wilder, Thornton N.  
Williams, Tennessee

### British playwrights

Barrie, Sir James M.  
Beaumont, Francis  
Behn, Aphra  
Bulwer-Lytton, Edward  
Chapman, George  
Congreve, William  
Coward, Sir Noel  
Davenant, Sir William  
Dekker, Thomas  
Dryden, John  
Eliot, T. S.  
Etherage, Sir George  
Farquhar, George  
Fletcher, John  
Ford, John  
Fry, Christopher  
Galsworthy, John  
Gascoigne, George  
Gay, John  
Gilbert and Sullivan  
Goldsmith, Oliver  
Granville-Barker, Harley

Greene, Robert  
Heywood, Thomas  
Jonson, Ben  
Kyd, Thomas  
Lyly, John  
Marlowe, Christopher  
Marston, John  
Massinger, Philip  
Maugham, W. Somerset  
Osborne, John  
Piner, Sir Arthur Wing  
Pinter, Harold  
Priestley, J. B.  
Shakespeare, William  
Shaw, George Bernard  
Sheridan, Richard Brinsley  
Stoppard, Tom  
Vanbrugh, Sir John  
Webster, John  
Wilde, Oscar  
Williams, Emyln  
Wycherley, William

### French playwrights

Anouilh, Jean  
Beaumarchais, Pierre  
Beckett, Samuel  
Brieux, Eugène  
Camus, Albert  
Claudel, Paul  
Cocteau, Jean  
Corneille, Pierre  
Dumas, Alexandre, *pere*  
Dumas, Alexandre, *fils*  
Genet, Jean

Giraudoux, Jean  
Hugo, Victor  
Ionesco, Eugène  
Marivaux, Pierre  
Molière  
Musset, Alfred de  
Racine, Jean  
Rostand, Edmond  
Sartre, Jean-Paul  
Scribe, Augustin Eugène  
Voltaire

### German language playwrights

Brecht, Bertolt  
Büchner, Georg  
Dürrenmatt, Friedrich  
Frisch, Max  
Goethe, Johann W. von  
Hauptmann, Gerhart  
Hofmannsthal, Hugo von

Kaiser, Georg  
Kleist, Heinrich von  
Lessing, Gotthold Ephraim  
Schiller, Johann von  
Schnitzler, Arthur  
Sudermann, Hermann  
Wedekind, Frank

### Irish playwrights

Boucicault, Dion  
Dunsany, Lord  
Gregory, Lady

O'Casey, Sean  
Synge, John Millington  
Yeats, William Butler

### Italian playwrights

Alfieri, Vittorio

Goldoni, Carlo

Pirandello, Luigi

### Russian playwrights

Chekhov, Anton  
Gogol, Nikolai

Gorki, Maxim  
Pushkin, Alexander

### Scandinavian playwrights

Björnson,  
Björnstjerne  
Holberg, Ludvig

Ibsen, Henrik  
Lagerkvist, Pär F.

Strindberg, August

### Spanish playwrights

Benavente, Jacinto  
Calderon de la Barca, Pedro  
García Lorca, Federico

Tirso de Molina  
Vega, Lope de

### Ancient Greek and Roman playwrights

Aeschylus  
Aristophanes  
Euripides  
Menander  
Plautus

Seneca, Lucius A.  
Sophocles  
Terence  
Thespis

### Other playwrights

Bhavabhuti  
Čapek, Karel  
Fugard, Athol

Havel, Václav  
Maeterlinck, Maurice  
Molnár, Ferenc

### Other related articles

Burlesque  
Comedy  
Masque  
Miracle play  
Morality play

Musical  
comedy  
Mystery play  
Opera

Passion play  
Tragedy  
United States (Arts  
[pictures])

### Outline

- I. Forms of drama
- II. The structure of drama
- III. Greek drama
- IV. Roman drama
- V. Medieval drama
- VI. Italian Renaissance drama
- VII. Elizabethan, Jacobean, and Caroline drama
- VIII. The golden age of Spanish drama
- IX. French neoclassical drama

- X. European drama: 1660-1800
- XI. Asian drama
- XII. Romanticism
- XIII. Early realism
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- XV. Modern drama since World War II

### Questions

What are three leading theories about the origin of drama?  
What was the influence of Thomas Kyd on Elizabethan drama?  
What is the function of the plot of a play?  
What were the theories that shaped French neoclassicism?  
What were some differences between Old Comedy and New Comedy?  
What was the comedy of manners? What was emphasized in a sentimental comedy?  
What contribution did the Greek playwright Sophocles make to dramatic form?  
What is the theme of most absurdist drama?  
What were Victor Hugo's contributions to the rise of romanticism in drama?

**Draughts** is a game played on a draughtboard by two people. The draughtboard most often used has 64 alternating dark and light squares. Each player has 12 round, flat pieces called *men* or *draughtsmen*. In most games, one set is black and the other red or white. The players sit opposite each other, and each arranges his or her men on the first three rows of black squares, one man per square. Two centre rows remain open.

The player with the black men starts by moving one black piece diagonally towards the red pieces. Then the other player moves a red man towards the black. The men can be moved forwards only, and only on the black squares. Men move one square only unless making a capture.

The object of the game is to capture or block all the opponent's men. A man captures an opponent's man on an adjacent square by jumping over it and landing on the square immediately beyond, which must be vacant. A man may make more than one capture in a single turn.





**Setting up the draughtboard**, players on opposite sides place 12 men on the first three rows of black squares. A black square must be on the lower left in setting up the board.



**A chalk drawing** can be as delicate and realistic as a painting. The Flemish artist Peter Paul Rubens used black, red, and white chalk to draw this expressive portrait of his wife.

Usually, a player is required to make a capture if possible. All captured men are removed from the board.

If a man reaches the back line on an opponent's side, it is *crowned* and becomes a *king*. A second piece is placed on top of the king to distinguish it from the other pieces. A king can move and jump backwards or forwards.

**Dravidians** were among the earliest known inhabitants of India. Their descendants now live mainly in southern India and trace their ancestry back at least 4,500 years. Dravidians and Indo-Aryans form the two major ethnic groups of India.

The term *Dravidian* also refers to a family of about 20 languages. Four of the languages are spoken by over 240 million Indians, about 30 per cent of the country's population. The Indian government has formed separate states based on these four languages. Tamil is spoken in the state of Tamil Nadu, Telugu in Andhra Pradesh, Kannada in Karnataka, and Malayalam in Kerala.

The origin of the Dravidians remains unknown. But ruins of the cities of Harappa and Mohenjo-Daro in the Indus Valley Civilization, which began about 2500 B.C., revealed an advanced culture thought to be Dravidian. About 1500 B.C., a people of central Asia called the Aryans invaded northern India and forced the Dravidians south. From about the A.D. 300's to 600's, Dravidian kings valued *Brahmans* (Hindu priests and scholars) from northern India for their literary skills and adopted much of their heritage.

Since the early 1900's, however, Dravidians have organized movements against remaining aspects of the Brahman heritage. During the 1960's, Tamil-speaking Indians were especially violent in protesting against a ruling that would have made Hindi, an Indo-European language, India's only official language. Today, 4 of the country's 16 official languages are Dravidian.

See also **India** (People; History).



**A crayon drawing** may have a forceful, dramatic quality. The German artist Hans Hofmann drew his forms in crayon and outlined them in ink to create this almost abstract picture of a town.

**Drawbridge.** See **Bridge** (Drawbridges); **Castle.** **Drawing** is the act of making a design or image, using line or tone, on any suitable surface. The design or image itself is also called a drawing.

The drawing of images on surfaces extends back to the prehistoric era. Examples of prehistoric drawings can be found throughout the world. The caves at Lascaux in France depicting curious mythical creatures





A **pen-and-ink drawing** shows how forms can be developed by the combination of lines and blank areas. Artists often choose pen and ink to create a drawing with many details.

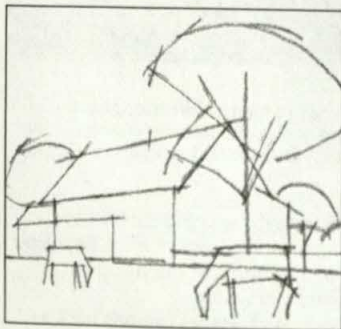
are a fine example of prehistoric drawings. These ancient creatures demonstrate clearly the need of humans over the ages to express themselves visually.

Drawing has many functions. It may be employed for technical purposes, but it is chiefly used for artistic reasons. This article discusses drawing as a fine art. For information on technical drawing, see **Technical drawing**.

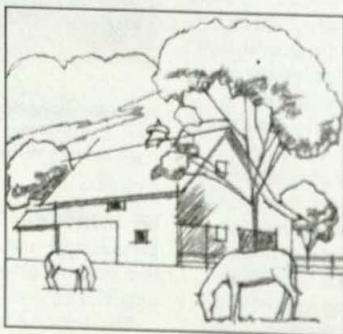
**Purposes.** Artists create drawings for a variety of purposes. Many make preliminary drawings to help them develop the composition of a painting or sculpture. They also produce drawings as finished works of art. Artists may use drawings to record information for future use. For example, an artist may draw a detailed sketch of a tree and refer to the drawing later when incorporating the tree into a painting. Art students draw figures and objects to gain skill with various kinds of line and form.

### Making a drawing

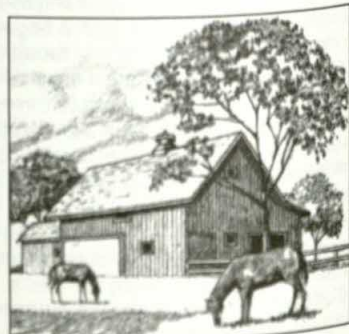
By following the steps shown below, an artist can create a drawing that is lifelike and has the proper proportions. This method can be used for a single figure or a complete composition.



First, the artist sketches the chief elements of the drawing in a series of simple curved and straight lines.



Next, the artist refines the lines to make the drawing more realistic. Details and shading are added to show solid forms.



Finally, the artist completes the drawing by adding textures and tones to the figures. Unwanted lines can then be erased.

**Materials and techniques.** Artists draw with chalk, charcoal, crayon, or pencil. They may use a liquid, such as ink, applied with a brush or pen. Artists also scratch drawings into a surface. For example, a *silverpoint drawing* is made by scratching into specially coated paper with a silver instrument or silver wire. A pointed instrument of gold, copper or lead can be used too, but silver is generally preferred for the permanence of the mark it leaves on the paper.

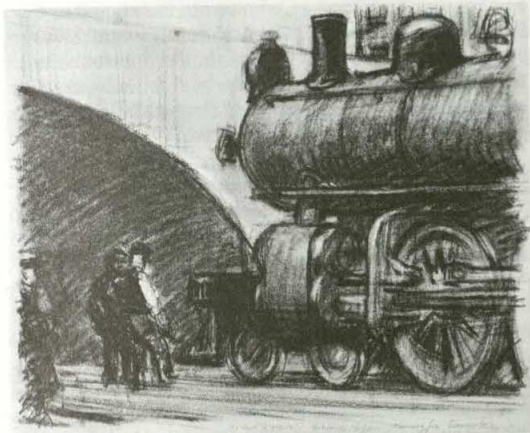
Manufacturers produce chalk and ink in a wide range of colours. Brushes, pencils, and pens are made in a variety of widths to create different kinds of lines. Artists can add tone to a drawing by applying a thin layer of liquid colour called a *wash*. They also may combine several materials and a range of techniques in producing one drawing.

Almost any surface can be used for a drawing. Prehistoric people drew on clay and stone, and the ancient Chinese used silk cloth. In the Middle Ages, many artists drew on parchment. Since the 1400's, paper has been the most popular surface because it is inexpensive and easy to carry. Drawing paper is made in a wide range of colours and textures, and also in various degrees of absorbency.

**History.** People have made drawings since prehistoric times. This art form first gained popularity among European artists during the 1400's, when paper became generally available. Since then, each century has produced artists who have created drawings that are regarded as masterpieces today.

Masters of drawing in the 1400's and 1500's included Leonardo da Vinci, Albrecht Dürer, Michelangelo, and Raphael. During the 1600's, Claude, Nicolas Poussin, Rembrandt, and Peter Paul Rubens created important drawings. In the 1700's, great drawings were produced by Jean Honoré Fragonard, Francisco Goya, Giovanni Battista Tiepolo, and Antoine Watteau. The masters of drawing during the 1800's included Paul Cézanne, Jacques Louis David, Edgar Degas, Théodore Géricault, Jean Ingres, Odilon Redon, Henri de Toulouse-Lautrec, and Vincent Van Gogh. Great drawings in the 1900's have been created by Max Beckmann, Willem De Kooning, Arshile Gorky, Edward Hopper, Paul Klee, Oscar





**A charcoal drawing** can effectively portray large, solid forms. The American artist Edward Hopper emphasized dark, heavy shapes to show a massive locomotive in front of a dark tunnel.

Kokoschka, Käthe Kollwitz, Henri Matisse, Jules Pascin, and Pablo Picasso.

See also **Leonardo da Vinci** (pictures); **Painting** (Watercolour painting); **Cartoon**; **Comics**.

**Drawing, Technical.** See **Technical drawing**.

**Drayton, Michael** (1563-1631), was an English poet who experimented with many literary forms. He wrote a number of love sonnets, but he concentrated on English patriotic themes in his works.

Drayton was born in Warwickshire and settled in London about 1591 to pursue a literary career. His first works included the sonnets *Idea, the Shepherd's Garland* (1593) and *Idea's Mirror* (1594). Drayton's major work was his long poem *Poly-Olbion* (1612-1622), a geographical and historical survey of England's counties. It was influenced by Edmund Spenser's epic poem *The Faerie Queene*. Drayton's poem *Nymphidia* (1627) pays homage to Geoffrey Chaucer, Spenser, and William Shakespeare in a mythological setting.

**Dreadnought** was a type of battleship first launched by the British Navy in 1906. It is also spelled *dread-naught*. It had heavy armour plate, and batteries of big guns in turrets. Shipbuilders later developed the more powerful superdreadnought.

See also **Warship**; **Navy** (Engineering advances).

**Dream** is a story that a person "watches" or appears to take part in during sleep. Dream events are imaginary, but they are related to real experiences in the dreamer's life. They seem real to the dreamer while they are taking place. Some dreams are pleasant, others are annoying, and still others are frightening (see **Nightmare**).

Everyone dreams, but some people never recall dreaming. Others remember only a little about a dream they had just before awakening and nothing about earlier dreams. No one recalls every dream.

**What dreams consist of.** The events of a dream usually form a story. In some dreams, the dreamer takes part in the story. In others, the dreamer merely "watches" the tale unfold. In most dreams, the dreamer cannot control what is happening, there is little logical thought, and events occur that could not happen in real

life. Occasionally, the dreamer will realize that he or she is dreaming and may be able to alter what happens in the dream. This is known as a *lucid dream*.

People see in most dreams, and they may also hear, smell, touch, and taste in them. Most dreams occur in colour, though the colour is often recalled only vaguely. Dreaming thought seems to put things together in new and unexpected ways. In some cases, this has led to important scientific discoveries or highly creative works.

**The biology of dreams.** Dreaming, like all mental processes, is a product of the brain and its activity. Whether a person is awake or asleep, the brain continuously gives off electrical waves. Scientists measure these waves with an instrument called an *electroencephalograph* (see **Electroencephalograph**). At most times during sleep, the brain waves are large and slow. But at certain times, they become smaller and faster.

During periods of fast brain waves, the eyes move rapidly as though the sleeper were watching a series of events. This stage of sleep, called *REM* (Rapid Eye Movement) *sleep*, is when most dreams occur. If awakened during REM sleep, the person is likely to recall details of the dream. Most adults have three to five REM periods each night. They occur every 90 to 100 minutes and last from 5 to 30 minutes each. But some people report dreams from non-REM periods.

During REM sleep, the pathways that carry nerve impulses from the brain to the muscles are blocked. Therefore, the body cannot move during dreams. Also, the *cerebral cortex*—the part of the brain involved in higher mental functions—is much more active during REM sleep than during nondreaming sleep. The cortex is stimulated by *neurons* (nerve cells) that carry impulses from the part of the brain called the *brain stem*.

**The meanings of dreams.** Many experts who study dreams also feel that they are related to deep wishes and fears of the dreamer, and several theories explaining the meaning of dreams have been developed. During the 1890's, Sigmund Freud, an Austrian doctor who originated psychoanalysis, developed one of the best-known theories of dream interpretation. Freud suggested that dreams are fulfilments of wishes, usually in disguised form. The disguise—or "dream language"—involves *condensation* (combining several ideas into one image), *displacement* (shifting a feeling from one idea or person to another), and *symbolism* (the use of symbols to represent what cannot be pictured directly).

Some scientists have suggested that biological discoveries about dreaming have made psychological theories of dreaming, such as Freud's, unnecessary or false. These scientists argue that a dream is a meaningless response of the cerebral cortex to random stimulation from the brain stem. However, waking thought is also a response of the cerebral cortex to stimulation, often random, from the brain stem.

**Functions of dreams.** The function of dreaming is not completely understood. Dreaming sleep may play a role in restoring the brain's ability to handle such tasks as focused attention, memory, and learning. In addition, most psychiatrists and psychologists still believe that a person's hidden feelings often surface in dreams. Psychotherapists therefore analyse patients' dreams in an effort to help the patients understand themselves better.

**Dreamtime.** See **Australian Aborigines** (Beliefs).





**Dredging** requires powerful equipment called *dredgers* that operate like steam shovels. Dredging is necessary to remove silt from the bottom of rivers, harbours, and other waterways so that ships can navigate them safely. The dredging unit shown above is clearing the shipping lanes in the port area of the Savannah River in Georgia, U.S.A.

**Dredging** is the work of clearing out the bottom of rivers, harbours, and other bodies of water so that ships can use them. The machines that do the work are called *dredges*. They work as a *power shovel* does on land (see **Construction equipment**). Dredges usually are run by steam or diesel engines.

The *dipper dredge* has a large scoop shovel, or *dipper*, shaped like a box which hangs on a chain from a long steel beam. The steel beam, or *derrick*, is attached to a strong mast which can swing the beam and dipper in a wide semicircle. The chain can be wound and unwound to raise and lower the dipper, and the derrick also can be raised and lowered.

When the dredging begins, the dipper is lowered to the bottom of the river or harbour. The derrick arm is swung in a semicircle to drag the dipper across the bottom so that it scoops up dirt and mud. Then the dipper is raised above the water and swung above a barge nearby. The bottom of the dipper has a door which is pulled open by a long cord to dump the dirt into the barge. Then the dipper is again lowered beneath the water to dig more mud.

The *hydraulic dredge* is most efficient for moving large quantities of beach or river sand. A suction pipe carries the sand and water to a pump. A discharge pipe leads from the pump to a barge or to a disposal area. Earth deposited by this process for dams, dykes, or building sites is called *hydraulic fill*.

See also **Gold** (The dredge); **Mining** (Surface mining methods; picture).

**Dreiser, Theodore** (1871-1945), ranks as the foremost American writer in the *naturalism movement* (a sombre and pessimistic form of realism). Dreiser's characters are victims of apparently meaningless incidents which result in pressures they can neither control nor understand. He based such novels as *Sister Carrie* and *American Tragedy* on events from real life. He condemned not his villains, but the repressive, hypocritical society that produced them. His style lacks grace, but his best stories are powerful and sobering.

Dreiser was born in Terre Haute, Indiana. His older

brother was Paul Dresser, who wrote the song "On the Banks of the Wabash, Far Away." Dreiser's family was very poor, and he soon saw a profound difference between the promise and the reality of American life. This realization was a major source of Dreiser's discontent and an important influence on his works.

Dreiser attended Indiana University for a year. In the 1890's, he worked as a newspaperman in Chicago and St. Louis. By 1907, he was the successful editor of the very sort of woman's magazine whose sentimentality and superficiality he despised.

Dreiser's first novel, *Sister Carrie*, was partly based on the experiences of one of his sisters. The novelist Frank Norris, an editor at Doubleday, Page, and Co., enthusiastically accepted the manuscript for publication. But Neltje Doubleday, wife of the president of the company, was shocked by the manuscript's amorality, and the publisher tried to cancel the contract to publish the book. Dreiser insisted the agreement be honoured. Doubleday printed the book in 1900, but did not advertise or distribute it. The novel became generally available in 1912, after another publisher issued it.

*Sister Carrie* is the story of Carrie Meeber, a poor girl alone in Chicago. She lives with a travelling salesman and then runs off to New York with George Hurstwood, a prosperous married man. Hurstwood's fortunes decline, and he becomes a tramp and commits suicide. Carrie finds success, but not happiness, as an actress.

Dreiser wrote *Jennie Gerhardt* (1911), another novel of desire and fate. However, his reputation was assured with the publication of *The Financier* (1912), the most purely naturalistic of his works. It is the story of an industrial tycoon who claws his way to great power. Dreiser intended the novel as the beginning of a "Trilogy of Desire." But the second volume, *The Titan* (1914), was a failure, and the third volume, *The Stoic*, was not published until two years after his death.

*An American Tragedy* (1925) is possibly the most impressive of Dreiser's books. It concerns a weak young man who is executed for the murder of his pregnant girl friend. Again, Dreiser did not condemn his villain, but the society that produced and destroyed him. See **Naturalism**.

**Dresden** (pop. 490,571) is one of the largest cities in Germany and a major European art centre. The city lies on both banks of the Elbe River in east-central Germany. For location, see **Germany** (political map).

Dresden was one of the most beautiful cities in Europe before World War II (1939-1945). In February 1945, Allied bombing raids killed thousands of people in Dresden and destroyed much of the city, including most of its architectural monuments. Restoration of these historic buildings has been underway since the 1950's. The first historic building to be restored was the Zwinger, a museum complex that is an outstanding example of the decorative Baroque architectural style. The Zwinger, which was built during the 1700's, houses a magnificent art collection. Its treasures include many porcelain artworks, jewels, and paintings by famous old masters.

Much of Dresden has been rebuilt in a modern style since 1945. The city has many broad streets lined with boxlike concrete buildings. Dresden's main shopping area lies along Pragerstrasse, a street reserved for pedestrians.



Dresden is more important as an area of industrial research and development than as a manufacturing centre. Its products include drugs, electronics equipment, furniture, optical and precision instruments, and machinery. The world-famous Dresden china is produced in nearby Meissen (see **Dresden china**).

German settlers from Meissen founded Dresden in the early 1200s. In the 1400s, the city became the capital of Saxony, the kingdom of a people called Saxons. During the next 400 years, Saxon rulers established and enlarged Dresden's art collection and made the city an important art centre. After Saxony became part of the German Empire in 1871, Dresden also gained importance as a commercial centre.

The German government hid Dresden's art treasures outside the city during World War II. Soviet troops seized the collection in 1945, but most of the works were returned in the mid-1950s. Although much of the city has been rebuilt since World War II, Dresden has a drab appearance in comparison with its former splendour.

**Dresden china** is a type of porcelain produced in Meissen, Germany, near the city of Dresden. The Meissen factory became the first manufacturer to produce true porcelain in Europe.

The first great artistic period at the Meissen factory began in 1720, under the direction of Johann Höroldt, a German painter. Höroldt specialized in enamelling Chinese landscapes and European scenes on porcelain (see **Enamel**). In 1733, the German sculptor Johann Kändler became factory director and designed beautiful Meissen porcelain ornamental figures and tableware. Kändler designed the famous *Swan Service* (1737-1741), a set of tableware in which the pieces were decorated with the raised figures of dolphins, swans, water plants, and mythical maidens. Kändler also introduced realistic porcelain flowers, which became one of the Meissen factory's most distinctive designs.

The Meissen factory still produces porcelain today. Its trademark of two crossed swords remains one of the most famous in pottery.

See also **Porcelain**; **Böttger, Johann Friedrich**.

**Dress.** See **Clothing**.

**Dressmaking.** See **Sewing**.

**Drew, Charles Richard** (1904-1950), was an American doctor known for his research on blood plasma and for setting up blood banks. Drew convinced doctors to use plasma, the liquid part of blood, for battlefield and other emergency transfusions. Previously, whole blood had been used for such transfusions. Plasma can be stored for long periods. But at the time that Drew conducted his research, whole blood could not be kept for more than a week. Also, unlike whole blood, plasma can be given to a person of any blood type. During the early part of World War II (1939-1945), Drew organized many blood banks to collect and distribute plasma. The plasma collected saved millions of lives.

Drew was born in Washington, D.C. He graduated from McGill University Medical School in 1933 and joined the Howard University faculty in 1935. Drew did most of his research on plasma at Columbia University from 1938 to 1940. In 1940, Drew directed American efforts to send plasma to Britain. In 1941, he became the first director of a Red Cross programme that collected



A Dresden china bowl designed in about 1737 by Johann Kändler as part of a tableware set called the *Swan Service*.

plasma for the U.S. armed forces. Drew left the Red Cross that same year and became a professor of surgery at Howard University. He received the Spingarn Medal in 1944. That same year, Drew was appointed chief of staff at Freedmen's Hospital, which is associated with Howard. He became medical director of the hospital in 1946.

**Dreyfus, Alfred** (1859-1935), was a Jewish French army officer who became the centre of a bitter quarrel as a result of political injustice. He was arrested on Oct. 15, 1894, on suspicion of spying for Germany. In December, a military court found him guilty. It suspended him from the army and sentenced him to life imprisonment on Devils Island.

Throughout the trial, Dreyfus maintained that he was innocent. In 1896, a member of the French general staff, Georges Picquart, found documents that convinced him of Dreyfus' innocence. But his superiors ordered him to drop the matter. Many noted people worked to get Dreyfus a new trial. Émile Zola wrote *J'accuse*, demanding justice (see **Zola, Émile**).

He received a second trial in 1899, but it was a mockery, because feeling against Jews was so bitter in the army. Many officials felt that the case was closed and that the army's honour was at stake. Testimony favourable to Dreyfus was barred, and the court again found him guilty. He was sentenced to 10 years' imprisonment, but President Émile Loubet pardoned Dreyfus after he had been confined for only a few days. Eventually, in 1906, the case was reviewed by the highest court in France, and Dreyfus was declared innocent.

In 1918, Dreyfus became a lieutenant colonel in the French Army, and was enrolled in the Legion of Honour. At the outbreak of World War I, he commanded one of the forts defending Paris. Dreyfus was born in Mulhouse, Alsace.

**Drill**, also called a *seeder*, is a tractor-drawn machine used to place seeds of small grains and grasses into soil. It plants seeds at the same depth in narrow rows spaced about 15 to 20 centimetres apart. The mechanism consists of a disc or hoe opener, a hopper, seed metering devices, and press wheels or short chains. The opener digs *furrows* (ploughed rows) in the soil. The hopper is



a long, narrow box that contains the seed to be planted. The seed metering devices are attached to the bottom of the hopper. They send measured amounts of seed through tubes into the furrows. The chains or press wheels then cover the seeds with soil.

There are two types of drills—*end-wheel* and *press-wheel*. An end-wheel drill is supported by two wheels, one at each side of the machine. The wheels drive the metering devices by means of gears and chains. Press-wheel drills are supported by wheels mounted behind each ploughing piece. These wheels drive the metering devices, close the furrows, and press soil around the seed. Drills may be equipped with devices that plant seeds of grasses, alfalfa, and clover.

**Drill** is a tool used to bore holes into a variety of materials. These materials range from soft soil to hard rock, metal, plastics, and concrete. Drills are widely used to bore holes into wood or metal so screws or other fasteners can be inserted. Construction workers use drills to break up pavement and to dig foundations for buildings. Energy companies rely on drills to dig for oil and natural gas and to get rock samples. Dentists use small drills to remove tooth decay.

Some drills are small and hand operated. There are also hand-held power drills. Drills called *drill presses* are mounted on tables or stand on the floor. Large drills must be mounted on masts supported by trucks or rigs.

The first drills were slender pieces of wood with points of sharp rock bound to them. They were invented about 4000 B.C. The Italian artist and inventor Leonardo da Vinci designed the first mechanical drill about A.D. 1495. The first practical hand-held power drill was patented in 1917. This article describes tools that drill metal, wood, and rock.



A hand-held power drill is a useful tool for carpenters and for hobbyists who enjoy crafting objects from wood.

**Metal drills** turn a slender steel rod called a *bit*. Bits are removable and come in various sizes to make different-sized holes. One end of the bit fits into the drill. The other end has one or more cutting edges, called *lips*. When the drill turns the bit at a high speed, the lips cut into the metal to make a hole. Bits also have grooves, called *flutes*. As the bit rotates, flutes direct metal shavings out of the hole to stop the drill from jamming. Flutes also allow cooling liquids to flow into the hole.

Most metal drill bits are *twist bits*. Twist bits have two or more lips and two or more spiralling flutes. A special bit called a *spade bit* is used in many manufacturing processes to drill deep holes. A spade bit is a flat blade with one lip. The bit is clamped in a holder before it is fitted into the drill.

**Wood drills** usually use specially fluted twist bits called *auger bits*. An auger bit is easy to keep centred because it has a screwlike tip called a *feed screw*. Auger bits called *Jennings bits*, which have two spiralling flutes, are used in hand-operated drills. Hand-held power drills take auger bits called *power bits*, which have one spiralling flute.

**Rock drills** are power drills that use a hammering action, a ploughing action, or both. A *road breaker*, also called a *jackhammer* or a *pneumatic hammer*, rapidly hammers a chisel-like bit into such materials as concrete and tarmac. Jackhammers are often used to break up roads. They are also used to demolish buildings and to dig trenches.

Drills that plough without hammering are called *rotary* drills. Among rotary bits are *fishtails*, which have hardened carbon lips, and *diamond bits*. Diamond bits are studded with points of diamond to cut hard rock. They are often used in small, hand-held drills to get samples of underground rock or ore.

Rotary drills called *augers* have spiralling, steel screw threads. Augers are often used to drill oil wells (see *Petroleum* [Drilling an oil well]).

**Drilling.** See *Gas* (Producing gas); *Machine tool* (Hole machining); *Petroleum*.

**Drinkwater, John** (1882-1937), was a British playwright, poet, and biographer. He became known for his chronicle plays *Abraham Lincoln* (1918), *Mary Stuart* (1921), *Oliver Cromwell* (1921), and *Robert E. Lee* (1923). His play *Bird in Hand* (1928) was a comedy. He wrote his most popular biography, *Pilgrim of Eternity*, about Lord Byron.

Drinkwater also wrote books of verse, including *Olton Pools* (1916), *Collected Poems* (1923), *New Poems* (1925), and *Summer Harvest* (1934). He was born at Leytonstone, then a town in Essex, England.

**Drinking.** See *Alcoholism*.

**Driscoll, Jim** (1881-1925), was a British boxer who won fame as a master of the traditional *scientific* style of boxing, using the straight left as the principal punch. He held the British featherweight title from 1907 until 1913 and won the European title in 1912. In 1910, he won the first Lonsdale Belt ever awarded in the featherweight category. Driscoll was never world champion, but, in 1909, he outboxed the world champion Abe Attell in the United States. Under the New York laws of the time, bouts could be decided only by a knockout. Driscoll was born in Cardiff, Wales.

**Drive shaft.** See *Car* (The power train).





**Drogheda** is a historic Irish town. The twin towers of St. Lawrence's Gate date from the 1200's.

**Drogheda** (pop. 24,068) is an important seaport and manufacturing centre in Louth, in the Republic of Ireland. It is situated on the estuary of the River Boyne. Its imports include animal foodstuffs, coal, petroleum, paper, steel, and timber. Drogheda's industries include food processing, and the manufacture of cement and cement products, clothing, and plastics products.

**Dromedary**, also called *Arabian camel*, is a swift camel used mainly for transportation and food in dry parts of India, the Middle East, and Africa. It sometimes grows to be 2 metres tall. The dromedary has only one hump. It can live on small amounts of food and water and has great endurance for desert travel. The dromedary has a swinging pace and can travel at a rate of about 16 kilometres an hour. See also *Animal* (picture: *Animals of the deserts*); *Camel*.

**Scientific classification.** The dromedary belongs to the camel family, Camelidae. It is *Camelus dromedarius*.

**Drought** is a condition that results when the average rainfall for an area drops far below the normal amount for a long period of time. This condition is also called *drouth*.

Streams, ponds, and wells often dry up during a drought. Water supplies for agricultural, industrial, and personal uses are greatly reduced. Often the dry and

crumbled topsoil is blown away by hot, dry winds (see *Dust storm*). In areas that are not irrigated the lack of rain causes farm crops to wither. Livestock may die.

Extreme drought can lead to many human deaths. The deaths are rarely from starvation. They are usually from drought-related conditions. In time of drought, people become more vulnerable to disease, and less resistant to illness such as diarrhoea. In some parts of Africa as many as 25 per cent of children under the age of five died during droughts in the 1980's. Throughout the world, drought affects more people than does any other single type of disaster. And drought causes about 20 per cent of all disaster-related deaths.

### Countries affected by drought

The continent currently most seriously affected by drought is Africa. The Sahel, a region south of the Sahara, and Ethiopia both suffered the worst effects of the catastrophic drought in the 1980's. Drought conditions persisted in this region through the early 1990's when Sudan, in particular, experienced severe famine. Food aid helped to relieve the famine. Nevertheless, many thousands lost their lives. In sub-Saharan Africa, where about 75 out of every 100 people live by agriculture, many farmers were forced to abandon their villages and look for work to support their drought-hit families. Many people ended up in refugee camps, totally dependent on food aid. Others gave up scratching a living from the land and went to live in Africa's towns and cities.

Droughts occur in many developing countries of the world, but they need not necessarily result in severe food shortages, or famines. In India, many regions experienced severe drought from 1971-1973. Maharashtra, one of the worst affected states, organized massive food-for-work schemes. At its peak, about 5 million people were employed on public works such as dam and road building. Not a single death was attributed to starvation during this period. Other countries, such as Brazil and Kenya, have also adopted measures to try to reduce the damage done by droughts in those countries. Such measures have met with limited success.

Drought is not confined to countries in tropical and sub-tropical regions. From December 1975 to August 1976 a so called "strong drought" covered northwestern Europe. Losses, especially in agriculture, were estimated in billions of U.S. dollars.

Areas of the United States have suffered three bad droughts in the 1900's. From 1931 to 1938 the Great Plains region experienced one of the worst droughts in its history, and the effect was felt throughout the country. From 1950 to 1954 the Southwest and the southern Great Plains suffered a severe drought. The worst drought since the 1930's struck the Midwest, the northern Great Plains, and part of the Southeast in 1988. It caused serious damage to grain crops.

Major droughts have occurred in Australia 11 times since the mid 1800's, eight of them since 1900. A major cause of drought in Australia is the El Niño-southern oscillation phenomenon, a disturbance of the air and sea currents of the Indian and Pacific oceans. Drought can occur anywhere in Australia, but more droughts occur in the drier interior than in coastal areas because the rainfall is less dependable further inland.





**Drought** is a constant threat to thousands of Africans. Two causes of drought are overgrazing and deforestation (cutting down trees). With no vegetation, the topsoil blows away, leaving a barren subsoil.

**Drought control.** The economic damage caused by drought can to some extent be contained by planning. In Australia, for example, when severe droughts cause great economic loss, the federal government usually offers financial assistance to farmers. Improved transport routes to enable farmers to move their stock from drought areas, or bring in relief fodder are among the new measures for controlling the effects of drought. The farmers themselves try to improve their properties as a defence against the climate. They extend irrigation schemes or drill for water. They put up more fencing to keep their pastures in better condition. They store fodder in good years so that they will have food reserves in drought years. In some more remote areas they also plant an edible tree, called top feed.

Long-term measures to beat drought, such as the creation of artificial lakes, have been suggested. Water evaporating from the lakes might set up a rainfall cycle. But climatologists doubt whether such an idea would have a long-term benefit on the climate.

Another method that has been tried for changing the climate in drought-affected areas is *cloud seeding*. To produce rain, iodine crystals are scattered among clouds from aircraft. The water-vapour molecules in the clouds cluster around the crystals and make them heavy. Eventually the overloaded crystals fall to earth as rain. Unfortunately, this method works well only in areas where rainfall readily occurs naturally.

**Droving** is a term used for walking cattle over long distances. Until World War II (1939-1945), most cattle were transported by rail or walked to market. The length of a droving trip could be a few hours while cattle moved from the farm to a local market or railway line. But in countries like Australia, it could be as long as three months. The longest droving route in Australia was the Canning Stock Route, which ran for 1,400 kilometres from the Kimberleys, in northern Australia, to the goldfields at Kalgoorlie. With the introduction of good roads, large trucks replaced droving as the main means of moving cattle.

**Drowning** is death caused by suffocation in water or other liquid. Most drownings and near-drownings happen in water to people who did not intend to enter the water, such as people who go boating. Falling into cold water is particularly dangerous. A person who becomes submerged in cold water can be quickly overcome by extremes of cold. Even shallow water can be a danger. Children have drowned in paddling pools and even in bathtubs.

Drowning begins when water or other liquid is inhaled into the lungs. This can happen when a person is gasping for air while struggling to stay afloat. When water enters the airway that leads to the lungs, the muscles of the larynx contract, preventing more fluid from entering. However, the muscular contractions also prevent air from reaching the lungs. Without air, the victim stops breathing, loses consciousness, and, unless rescued, dies.

A person who cannot swim can avoid drowning by floating upon the surface of the water. Both swimmers and nonswimmers can learn effective floating techniques—often called *survival floating*—in swimming and water safety classes.

**Methods of rescue.** Only a person trained in water rescues should swim out to help a drowning person. Many rescuers are pulled underwater by struggling victims. Even a strong swimmer might be unable to subdue a victim and effect a rescue.

If the drowning person is close enough, reach out with a fishing pole, an oar, a tree branch, a belt, or a shirt or towel. Keep your body low to avoid being pulled into the water. If no such objects are near, firmly grasp a secure object, such as a pool ladder, and extend an arm or leg to the victim. If the person is too far to reach, throw a ring buoy or other floating object that the victim can grab and use to stay afloat. If the object is attached to a rope, throw it beyond the victim and pull it back within the victim's reach. Slowly pull the victim to safety.

Wade in to help the victim only if there is no danger from currents, objects on the bottom, or a sudden drop in the bottom. If possible, carry an item that will float, such as a cushion, raft, or lifejacket. Allow the victim to grasp one side of the object and pull the victim to safety, or allow the victim to grab the object and kick to safety. The object should always be kept between the rescuer and victim to prevent a panicky victim from pulling the rescuer under.

**Giving first aid.** If the rescued victim has stopped breathing, he or she should receive artificial respiration, also called *rescue breathing*, as soon as possible. The person administering artificial respiration must not give up quickly. People who have been submerged in extremely cold water for over an hour have been saved by artificial respiration. See **First aid** (Giving artificial respiration).

See also **Safety** (In water sports); **Swimming** (Water safety).





Capsules



Transdermal patch



Injectable drug



Tablets



Gel and cream



Liquid and inhalant

**Modern drugs** come in many forms and are administered in various ways. Most drugs are given orally. Drugs also may be applied to the skin, injected, or inhaled. Certain drugs may be obtained only with a doctor's prescription. Others may be purchased without a prescription.

## Drug

**Drug** is one of the medical profession's most valuable tools. Doctors prescribe drugs to treat or prevent many diseases. Every year, penicillin and other germ-killing drugs save the lives of countless victims of meningitis, pneumonia, and other dangerous infectious diseases. Vaccines prevent such diseases as measles, polio, and smallpox. Analgesics lessen or eliminate pain. The use of these and many other kinds of drugs has helped millions of people live longer, healthier lives than would otherwise have been possible.

Most of our useful drugs were unknown before the 1900's. For example, the sulphonamides (or sulpha drugs) and antibiotics, our best germ-fighting drugs, did not come into use until the late 1930's and early 1940's. Before that time, more than 30 per cent of pneumonia victims in the developed countries died of the disease. The new drugs quickly reduced the death rate from pneumonia. Polio vaccine was introduced in 1955. At that time, polio virus infected many thousands of people every year. Today, the disease does not occur in the West. Life expectancy too, has been almost doubled in Western countries.

But drugs can also cause sickness and death. Any drug, even a relatively safe one, may cause harm if it is used improperly. Aspirin, for example, is one of the safest and most useful drugs. Yet every year, aspirin kills children who mistake the pills for sweets and eat too

many of them. Any drug can kill if it is taken in a large enough dose. In addition, the widespread misuse of alcohol, narcotics, and certain other drugs has become a serious problem.

We generally use the word *drugs* to mean only medicines and certain other chemical substances that people use, such as alcohol or marijuana. But *pharmacologists*, the scientists who study drugs, consider all chemicals that affect living things to be drugs. For example, they classify insecticides, weedkillers, and a wide variety of other substances as drugs. Even the chemicals in car exhaust and other substances that pollute the environment act like drugs because they affect living things.

This article deals chiefly with drugs that are used for medical purposes. Detailed information on the misuse of drugs can be found in the article **Drug abuse**.

In recent years, scientists have made much progress in drug research. The side effects of drugs are now much better known. Many drugs with undesirable, or even dangerous, side effects have been replaced by safer ones. Advances in biochemistry and physiology have helped scientists to have a better understanding of certain drugs. For example, aspirin has been in use since the beginning of this century but only in 1971 was it possible to explain how the drug worked. However, because of this new knowledge, aspirin is now used to treat a much wider range of medical conditions.



The many kinds of drugs people use can be classified in several ways. For example, they can be grouped according to their form, such as a capsule, gas, or liquid. Or they can be classified according to the way they are taken, such as by swallowing, inhaling, or injection. Drugs can also be grouped according to their chemical structure.

Pharmacologists generally classify drugs according to the major beneficial effect they have on the body. Classified in this way, many of the most widely used drugs belong to one of about a dozen groups. Four especially important groups are (1) drugs that fight bacteria, (2) drugs that prevent infectious diseases, (3) drugs that affect the heart and blood vessels, and (4) drugs that affect the nervous system.

All drugs affect the body in more than one way. For example, some drugs taken to act on the nervous system also affect the heart. The drugs discussed in this section, however, are classified according to their chief effect on the body.

### Drugs that fight bacteria

Two main types of drugs kill or help the body kill bacteria: (1) antibiotics and (2) sulphonamides, or sulpha drugs. Doctors prescribe these drugs in treating meningitis, pneumonia, and many other infectious diseases. A large dose of penicillin or of certain other antibiotics kills disease-causing bacteria. A smaller dose of such an antibiotic keeps the bacteria from multiplying in the body and thus allows the body's natural defences to destroy them. Other antibiotics and the sulpha drugs also prevent bacteria from multiplying in the body. In most cases, however, these drugs do not kill the bacteria. See **Antibiotic; Sulphonamide**.

### Drugs that prevent infectious diseases

Two kinds of drugs prevent infectious diseases: (1) vaccines and (2) antiserums and globulins. Some of these drugs, such as polio vaccines, are especially valuable because there is no effective treatment for the disease they prevent.

**Vaccines.** There are several different kinds of vaccines. Each kind causes the body to produce substances, which are called *antibodies*, that fight a particular disease. The vaccine thus makes the body *immune* to the disease by providing resistance against attack by it. Vaccines have been developed against such infectious diseases as cholera, diphtheria, measles, smallpox, and whooping cough, as well as polio. In fact, vaccinations against smallpox have wiped out that disease. The last case of naturally occurring smallpox was reported in 1977. See **Immune system**.

**Antiserums and globulins**, like vaccines, prevent certain infectious diseases. But unlike vaccines, these drugs contain antibodies rather than substances that cause the body to produce antibodies. Therefore, the antiserums and globulins act more quickly than vaccines to prevent infection. Doctors prescribe these drugs after a person who has not been vaccinated is exposed to an infectious disease. Antiserums are used against such diseases as diphtheria and *tetanus* (lockjaw). Some examples of diseases against which globulins offer protection include hepatitis, rabies, and tetanus. See **Serum; Globulin**.

### Drugs that affect the heart and blood vessels

Drugs that affect the heart and blood vessels are known as *cardiovascular drugs*. Doctors prescribe them in treating diseases of the heart and blood vessels. Diseases of the heart and blood vessels rank as the chief cause of death from disease in industrial countries. There are four major kinds of cardiovascular drugs. They are (1) antiarrhythmics, (2) cardiotonics, (3) vasodilators, and (4) antihypertensives.

**Antiarrhythmics** steady the heartbeat. People take these drugs to treat *tachycardia* and *fibrillation*, conditions in which the heart beats irregularly and at a rate much faster than normal.

**Cardiotonics** strengthen the heartbeat. These drugs cause the heart to beat more forcefully and thus increase circulation of the blood. Doctors prescribe them to treat conditions in which the heart pumps too weakly. The most widely used cardiotonic drugs are digoxin and digitoxin.

**Vasodilators** enlarge, or *dilate*, small blood vessels. These drugs are taken mostly to treat narrowing of the coronary arteries, the vessels that carry blood to the heart. Drugs used to enlarge these arteries are called *coronary vasodilators*. Doctors prescribe them for people with such severe narrowing of the coronary arteries that they suffer chest pains while walking or exercising in some other way. Such people are said to have *angina pectoris*. The most widely used coronary vasodilators

### Rules for using drugs

**No drug is absolutely safe. Proper use is beneficial. Improper use is harmful.**

- 1. Do not take a drug prescribed for someone else.** Only a doctor or dentist can determine which drug will help you. A drug that works for someone else may not work for you because of differences in age, weight, or other physical characteristics. In addition, you may not have the same disease or disorder as someone else, even though the symptoms appear to be the same.
- 2. Do not save prescription drugs for later use.** Obtain a new prescription each time illness occurs. You may have an illness that seems the same as an earlier one but is actually different.
- 3. Do not keep nonprescription drugs too long.** All drugs change chemically in time. Some become weaker than intended. Other drugs contain substances that evaporate, making the medicines stronger than intended. If a drug label does not tell how long a drug will remain safe and effective, ask your pharmacist.
- 4. Follow all instructions on drug labels.** The label tells how much of a drug to take and how often. It also tells under what conditions you should not take the drug. It may be dangerous to use more of a drug than the amount prescribed or recommended, or to ignore any other label instructions.
- 5. Report unpleasant or unexpected drug effects** to your doctor or dentist. Any drug may produce an unusual, unexpected effect.
- 6. Keep all drugs in a safe place** away from children and pets. An overdose of any drug can cause sickness or even death.



are isosorbide dinitrate and nitroglycerin. Other kinds of drugs used in treating angina include calcium blockers and beta-blockers.

**Antihypertensives** are used in the treatment of *hypertension* (high blood pressure). Vasodilators and many other kinds of drugs are antihypertensives. Vasodilators lower blood pressure by causing the muscles in the walls of small blood vessels to relax. The blood is then able to flow at a lower pressure. Other antihypertensives act differently. Often, two or more kinds are given daily to the same patient.

### Drugs that affect the nervous system

Many of the most widely used drugs affect the brain and other parts of the nervous system. These drugs include alcohol; the caffeine in cocoa, coffee, and tea; marijuana; narcotics, such as heroin and morphine; and sleeping pills. Altogether, five major kinds of drugs are known to affect the nervous system: (1) analgesics, (2) anaesthetics, (3) hallucinogens, (4) stimulants, and (5) depressants.

**Analgesics** relieve pain without causing unconsciousness or diminishing the other senses, such as the sense of touch or taste. For example, an analgesic may relieve a person's headache, but it will not prevent that person from sensing heat or cold or from tasting and smelling food.

There are two main kinds of analgesics: (1) narcotics and (2) nonnarcotics. Both kinds relieve pain. But the narcotics also produce drowsiness, a dazed condition, and often a feeling of well-being. Aspirin is one of the most commonly used nonnarcotic analgesics. The most widely used narcotics are *opiates*, which are obtained from the opium poppy, and certain related *synthetic* (artificially produced) drugs. Opiates include codeine, heroin, and morphine.

Doctors sometimes prescribe narcotics in treating certain disorders. For example, morphine is used to relieve the pain of severe injury and of cancer. But excessive use of narcotics leads to drug addiction, a condition in which a person has become so dependent on the drug that illness results if use of the drug is stopped. For this reason, doctors prescribe narcotics only if other analgesics will not work. See **Narcotic**.

**Anaesthetics** eliminate sensation. *General anaesthetics* eliminate sensation throughout the body, thus causing unconsciousness. These drugs, which include halothane and thiopental, are given during many kinds of surgical operations. *Local anaesthetics* deaden the senses only in the area of the body to which they are applied. Dentists often give such local anaesthetics as lignocaine and procaine. Doctors use local anaesthetics for eye surgery and other operations that do not require the patient to be unconscious. See **Anaesthesia**.

**Hallucinogens** cause a person to *hallucinate*—that is, to see, hear, or otherwise sense something that exists only in the mind. These drugs are also called *psychedelic* (mind-revealing) drugs. They give people a distorted view of themselves and their surroundings. Hallucinogenic drugs include LSD, marijuana, and mescaline. Doctors have experimented with hallucinogens in the treatment of mental illness. See **Hallucinogen**.

**Stimulants** overcome sleepiness and tiredness. These drugs *stimulate*, or increase the activity of, the

nervous system. Stimulants include caffeine, cocaine, and synthetic drugs known as *amphetamines*. Common names for amphetamines include "speed," "uppers," and "wakeups." See **Amphetamine**. Stimulants create a sense of well-being in most users, in addition to increasing mental and physical activity. But many people become depressed and uneasy as the effects wear off. They may then take the drug again to feel better, and they thus become dependent on it. For this reason, doctors seldom prescribe stimulants for tiredness. See **Stimulant**.

**Depressants** reduce tension and worry. These drugs *depress*, or decrease the activity of, the nervous system. They include tranquillizers, sedatives, and alcohol.

**Tranquillizers** calm a person without causing much drowsiness if taken in a small enough dose. Larger doses make the user sleepy as well as calmer. Psychiatrists prescribe powerful tranquillizers in treating severe mental illness. These drugs may reduce a patient's extreme fears and worries. Many people who do not have severe mental illness but who have difficulty handling the stresses of everyday life take mild tranquillizers. However, the use of mild tranquillizers over a long period of time may make the user dependent on these drugs. See **Tranquillizer**.

**Sedatives**, like tranquillizers, have a calming effect. But sedatives have greater ability than tranquillizers to make a person sleepy. As a result, doctors generally prescribe sedatives for patients who suffer from *insomnia* (the inability to sleep naturally). The most widely used sedatives are a group of synthetic drugs called benzodiazepines. These drugs include diazepam and temazepam. There are also other sedatives, such as chloral hydrate and chlormethiazole. People who use a sedative on a regular basis may become dependent on the drug, and they may have to increase the dose for the drug to be effective. See **Sedative**; **Barbiturate**.

**Alcohol** is the common name for ethyl alcohol, the drug found in alcoholic drinks. Alcohol relaxes most people and makes them drowsy. The use of alcohol, like the use of most of the other drugs that depress the nervous system, may make a person dependent on it. See **Alcoholism**.

### Other kinds of drugs

People also use many other kinds of drugs besides those discussed above. These drugs include (1) diuretics, (2) hormones, (3) vitamins, (4) antitumour drugs, and (5) immunosuppressive drugs.

**Diuretics** increase the formation of urine. In certain diseases, the kidneys do not produce enough urine. As a result, fluid, salts, and wastes build up in the body. Diuretics correct this condition by causing the kidneys to produce more urine. Diuretics are also used to treat hypertension. See **Diuretic**.

**Hormones** are chemicals made by the body's glands. The hormones control many body functions, such as growth and reproduction. Certain animal hormones are similar to those produced by people, and scientists have created synthetic hormones. Natural and synthetic hormones are used as drugs in several ways.

Doctors prescribe hormones for patients whose glands produce insufficient amounts. For example, some people who have the disease diabetes mellitus do not produce enough of the hormone insulin. They must re-



ceive insulin injections. Doctors also prescribe hormones to treat diseases that do not result from a hormone *deficiency* (lack). The hormones ACTH and cortisol, for example, are used in treating rheumatoid arthritis.

Hormones are also used as *oral contraceptives*, or *birth control pills*, which prevent pregnancy. These drugs work by interfering with the normal reproductive processes in a woman's body. See **Hormone; Birth control** (Methods of birth control).

**Vitamins** are essential to good health. Such diseases as rickets or scurvy develop if a person has certain vitamin deficiencies. The best way to obtain vitamins is to eat a well-balanced diet. But if necessary, a doctor may prescribe vitamin pills or injections. See **Vitamin**.

**Antitumour drugs** destroy cancer cells. Although

many such drugs have been developed, they all injure normal cells as well as cancer cells. But some antitumour drugs have been used to lengthen the life of patients with incurable cancer. Scientists hope to develop drugs that will destroy only cancer cells.

**Immunosuppressive drugs.** If foreign proteins somehow get into the bloodstream, they act as *antigens*, causing white blood cells to make antibodies against them (see **Immune system**). This process also occurs when an organ from one person is transplanted into another person. The antibodies formed begin to destroy the transplanted organ. Immunosuppressive drugs interfere with the body's formation of antibodies. One use of such drugs is to prevent the destruction and rejection of transplanted organs. Azathioprine and cyclosporin A are examples of immunosuppressive drugs.

## How drugs work

Different drugs are *administered* (given) in different ways. But once in the body, almost all drugs work the same way—by altering the speed of cell activities.

**Entrance into the body.** Most drugs are administered orally. But drugs may also be given in several other ways. For example, they may be injected, inhaled, or applied to the skin. The method of administration depends on the form and purpose of a drug. An anaesthetic gas, for example, must be inhaled to produce unconsciousness. Ointments are applied directly to the area being treated.

Each method of administration has advantages and disadvantages. For example, the safest way to take a drug is *orally* (by swallowing it). But some drugs cannot be taken orally because stomach juices destroy them. Injected drugs act quickly in the body. But injection is painful, and it presents greater risk of infection than do other methods of administration.

Researchers are constantly developing new methods of administration. A device called a *transdermal patch* contains a layer of medication and is attached to the skin like a bandage. The patch slowly and continuously re-

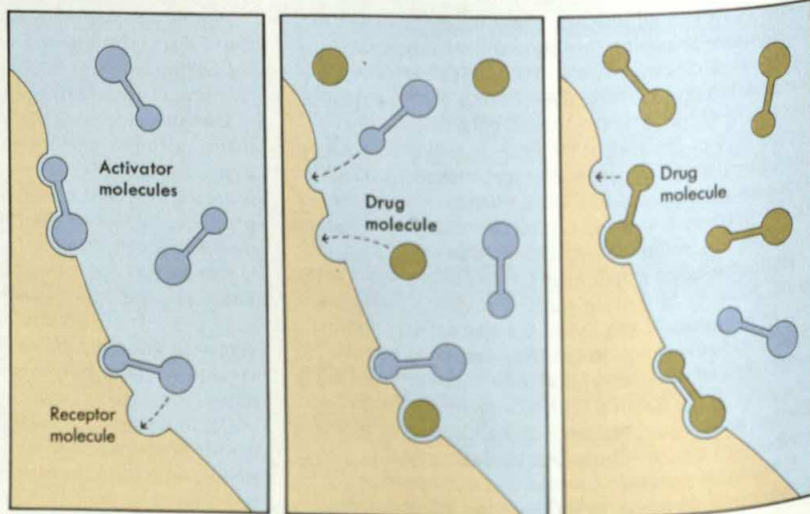
leases the drug, which seeps through the skin to the bloodstream. The coronary vasodilator nitroglycerin may be administered in this way. Another device, the *implantable pump*, consist of a small, metal disc with a chamber that can be filled with a drug. The pump is inserted in the body surgically and delivers the medication continuously. It may be refilled by injection.

**Action in the body.** Most drugs that are swallowed, inhaled, or injected enter the blood stream and travel throughout the body. They pass from the blood into the cells of the tissues where the drug action occurs. Only a few kinds of drugs—such as eye drops, local anaesthetics, and nasal sprays—act before entering the bloodstream. When these drugs eventually enter the blood, the amount is usually too small to produce additional effects on the cells.

Almost all drugs create their effects by altering cell activities. To explain how drugs act on cells, pharmacologists developed the *receptor theory*. According to this theory, chemical reactions in every living cell control the cell's activities. Each controlling reaction causes a particular cell activity to begin, to speed up, or to slow

### How the receptor theory explains drug action

According to the receptor theory, drugs produce their effects by attaching to *receptor molecules* in body cells. Normally, *activator molecules* produced in the body attach to a receptor molecule, *near right*. This chemical reaction causes a particular cell activity to speed up or slow down. Some drugs attach to a part of the receptor and thus keep the activator from forming a complete attachment, *centre*. As a result, the particular cell activity is blocked. Other drugs are so similar to the activator that they form complete attachments themselves, *far right*. In such cases, the cell activity increases.





down. A drug acts on a cell by altering one or more of these chemical reactions. It does so by attaching to *receptor molecules* in each cell that are normally involved in the controlling chemical reaction.

The receptor theory not only explains how drugs work, but it also points up what drugs can and cannot do. Because they react with receptors that control cell activities, drugs can only alter the speed of those activities. They cannot create new cell activities.

In most cases, the chemical reaction between a drug and the body is not a one-way process. Drugs alter cell activity, but normal body processes also change most drugs. These processes transform a drug into one or more new substances, most of which are weaker than the original drug. This changing of drugs is called *bio-transformation* or *drug metabolism*. It is one way in which the body protects itself against drugs. Most bio-transformation occurs in the liver. A diseased liver takes longer than a healthy liver to change a drug into a weaker substance. As a result, doctors generally reduce drug dosage for a patient with liver disease. Otherwise, the drug would last longer in the body and thus exert too great an effect.

**Effect on the body.** All drugs can affect the body in both helpful and harmful ways. For example, a particular drug may produce a stronger heartbeat, relief from pain, or some other desired effect. But that drug, like all drugs, can also cause undesired effects—especially if the dose is too large.

Most drugs produce changes throughout the body because the drugs circulate through the bloodstream. As a result, most drugs used to affect one part of the body also affect other parts. For example, doctors sometimes prescribe morphine to relieve pain. Morphine alters the activities of cells in the brain and spinal cord and thus reduces the sensation of pain. But morphine also alters the function of cells in the body that are not involved in sensing pain. It may decrease the rate of breathing, cause vomiting, produce constipation, and create other undesired effects.

In general, a drug's effects are strengthened as the dose is increased and weakened as the dose is decreased. But all people do not react the same to a change in the dose of a drug. Doubling the dose, for example, may triple the strength of the drug effects in one

person and not increase the effects in someone else.

The section *Kinds of drugs* describes the chief desired effects of various drugs. Effects other than those desired are called *adverse reactions*. Drugs produce three main kinds of adverse reactions: (1) side reactions, (2) hypersensitivity reactions, and (3) toxic reactions. The repeated use of alcohol, narcotics, and certain other drugs may create a condition called *drug dependence*.

**Side reactions**, or side effects, occur with all drugs. Doctors can anticipate these reactions and tell a patient what to expect. For example, many of morphine's harmful effects are side reactions and should therefore be expected. Most drugs cause weak side reactions that do not prevent use of the drug.

**Hypersensitivity reactions**, also called *allergic reactions*, occur only in people allergic to a particular drug. Some of these reactions are minor but others are severe. Any drug may cause an allergic reaction in people highly sensitive to that drug. Some people cannot take such common drugs as aspirin or penicillin because they are allergic to them.

**Toxic reactions** result from drug poisoning. Such reactions damage cells and may kill a person. All drugs can have a mild toxic effect, and a large enough overdose of any drug will produce a severe toxic reaction.

**Drug dependence.** People who repeatedly take large amounts of such drugs as alcohol, amphetamines, barbiturates, or narcotics may become dependent on the drugs. These people have an intense psychological or physical need for a drug's effects. **Tolerance**, or resistance to a drug's effects, usually develops along with drug dependence. As drug use continues, tolerance increases. The drug user must thus take larger and larger doses to obtain the desired effects. The development of physical or psychological dependence, or both, is commonly called *drug addiction*. In most cases, a severe withdrawal illness occurs if a person stops taking the drug. See **Drug abuse**.

**Elimination from the body.** The body eliminates drugs with other waste materials. Most drugs travel from the cells through the bloodstream to the kidneys and are eliminated in the urine. The body also eliminates drugs in sweat, tears, and solid wastes. Some anaesthetics are eliminated almost entirely in exhaled breath.

## How drugs are produced and sold

The production and sale of drugs used as medicines is a big business in many countries. The world's leading producers include France, Germany, Japan, Switzerland, the United Kingdom, and the United States.

This section deals chiefly with the production and sale of drugs.

### Sources of drugs

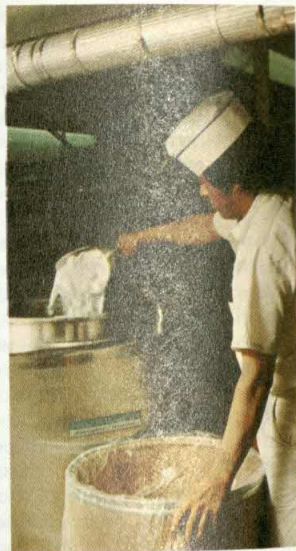
The pharmaceutical industry produces mostly synthetic drugs. Chemists working in the laboratories of drug companies create these drugs from chemical elements. Other drugs produced by the pharmaceutical industry are obtained from plants, moulds, animals, minerals, and genes and bacteria.

**Chemical laboratories.** Chemists have created many

of our most valuable medicines. Most of these drugs do not occur naturally. Synthetic drugs duplicate or improve upon those obtained from plants, moulds, bacteria, animals, or minerals. Pharmaceutical companies can produce many of these drugs at less cost and in greater quantity synthetically than by using the natural source. For example, the hormone hydrocortisone, used to treat arthritis and many other ailments, can be obtained from the adrenal glands of cows and sheep. But drug companies can produce it cheaper synthetically. In addition, the synthetic form of hydrocortisone causes fewer adverse reactions than the natural form of the hormone.

**Plants and moulds.** Drug companies make several important medicines from plants and moulds. These medicines include antibiotics, cardiotonics, and certain





**Some sources of drugs.** Most drugs are synthetic compounds created in drug company laboratories, *left*. Other drugs come from plants, animals, minerals, and bacteria. For example, opium poppies, *centre*, supply opium, used to make such narcotics as codeine and morphine. Sodium chloride, or salt, and other substances are used in preparing *intravenous solutions*, *right*, which are injected into the veins of patients who cannot eat or drink.

analgesics. For example, the antibiotic penicillin comes from a mould. The cardiotonic digitalis, a drug used to stimulate the heart, is obtained from the leaves of the purple foxglove, a flower. The pain reliever morphine is taken from opium, a drug that comes from the juice of the opium poppy. Plant drugs that pharmaceutical companies do not produce include such illegal drugs as marijuana and mescaline.

**Animals.** A number of important drugs—including several of the hormones used to treat arthritis, hormone deficiencies, and various other ailments—are obtained from the cells and tissues of animals. For example, millions of diabetics use insulin obtained from the pancreas of cattle and pigs. Doctors prescribe the hormone thyroxine, obtained from the thyroid gland of cattle and pigs, for patients whose thyroid gland produces too little of the hormone.

**Minerals.** Pharmaceutical companies produce several common drugs from minerals. For example, the mineral iodine is used in making tincture of iodine, a liquid that helps prevent infection when applied to cuts and bruises. The mineral silver nitrate is manufactured in powder form and rubbed onto wounds to stop bleeding and help prevent infection. Doctors also use silver nitrate in mild solution to treat or prevent certain eye and skin infections.

**Bacteria.** Biologists and chemists have learned how to insert human genes into bacterial cells, which then can make some of the same chemicals that human beings make in their own cells. The chemicals are removed from the bacterial cells and purified for administration to patients. Drugs made from bacteria include insulin and interferons. Interferons are chemicals produced by the body as a response to infectious diseases. Several members of the interferon group help control

viral infections. One or more of them may also be useful as antitumour drugs. See *Interferon*.

### Research and development

Pharmaceutical firms are continually developing new drugs. Although company chemists discover some new drugs by accident, the creation of most new products begins with an idea. This idea may be for a new kind of drug or for one that works better than existing drugs. A pharmaceutical company must then obtain such a drug, test it, and develop it into a safe, easy-to-use form. The entire process takes about 10 years for most drugs and is extremely expensive.

**Creating a new drug** is the task of a company's research chemists. They may make a new chemical compound or obtain the drug from a natural source. This work may take many months or even years. For example, researchers for one U.S. drug company spent two years testing soil from all parts of the world to find new antibiotics. The tests involved more than 100,000 soil samples. The entire project resulted in the development of one antibiotic, oxytetracycline, used to treat such diseases as bronchitis, pneumonia, and whooping cough.

In the process of creating a new drug, researchers perform tests with animals to see if the substance is safe and effective. They first give the substance to small animals, such as rats, mice, and guinea pigs. If the substance passes these tests, it is given to larger animals, such as dogs and monkeys. Researchers may test hundreds of substances before finding one that appears safe and effective. They then try to find out how this drug works, in what forms it can be given, how the animal body eliminates the drug, and what side effects it may have. The drug company then sends this and other information about the drug to the authority responsible



for the safety of drugs and asks for permission to conduct tests on people.

**Testing with people.** After receiving final approval, a drug company performs two series of *clinical trials* with the new drug. The company first tests the drug for safety in healthy human volunteers. If the results of these tests are satisfactory, the company checks the drug further in patients who have the disorder the drug is designed to correct.

Most clinical trials are supervised by a *clinical investigator*, a doctor employed by the drug firm's research department. Doctors on the staffs of large hospitals cooperate with the clinical investigator by arranging for volunteers to take part in the second series of trials. The number of patients who receive the drug and the length of the trials depend on the disorder being treated and the kind of drug being tested. Most trials involve hundreds of patients and last from several months to a year. Some trials, however, involve thousands of patients and last several years.

Careful testing is one of a pharmaceutical company's most important responsibilities. Drug companies and government regulatory departments constantly guard against the possibility of a harmful drug being given to the public. But even the most careful testing cannot always reveal the possibility that a drug might produce an unexpected harmful effect. A tragic example of such an unexpected effect occurred in Europe during the early 1960's. Thousands of pregnant women who took a new sedative, thalidomide, gave birth to babies with no arms or legs or with other deformities. The chances of such severe effects occurring unexpectedly are, however, very small.

The drug company's clinical investigator and other scientists evaluate the results of the clinical trials. They also compare the new drug with those already in use. Other doctors and scientists continue to study the effects of the drug in animals. If the company decides it has developed a safe, effective drug, it will request approval to sell the drug.



**Tests with animals** help researchers determine if a new drug is safe and effective. As part of the tests, each animal is weighed, *above*, to see if the drug's effects differ among animals of different sizes.

**Developing the finished product.** Before selling a new drug, a company must develop it into a safe, easy-to-use form. Researchers determine what ingredients to add to the drug to make it into a capsule, liquid, pill, or other usable form. These ingredients, called *excipients*, must not interfere with the drug's action. Researchers also determine how fast the drug will break down chemically and lose its effectiveness. After all these steps, the company is ready to plan mass production of the drug.

### Drug names

All drugs produced by the pharmaceutical industry are given at least two names: (1) a chemical name and (2) a *generic name*. In addition, a drug may have one or more trade names. For example, a certain diuretic has the chemical name 6-chloro-3, 4-dihydro-7-sulfamyl-2H1,2,4-benzothiadiazine, 1,1-dioxide. Its generic name is hydrochlorothiazide. The drug also has many trade names, including Esidrex, HydroDiuril, HydroSaluric, and HydroSovluric.

**The chemical name** of a drug describes its chemical structure. It is the only name that identifies a drug exactly. But because most drugs have long, difficult chemical names—such as the above example—these names are not commonly used.

**The generic name** is usually an abbreviated chemical name. It provides a hint about a drug's chemical structure, as the name *hydrochlorothiazide* does in the example. But the generic name does not describe a drug completely. It is shorter than the chemical name, and easier to use.

**The trade name** is given to a drug by the company that sells it. A number of firms may sell a particular drug. Each company may give the drug a different trade name, or it may market the drug under the drug's generic name.

### History

Prehistoric peoples probably used drugs long before the first civilizations arose. It is likely they discovered that their aches and pains disappeared after they ate certain plants. They may have also noticed that animals ate certain plants only when ill and then recovered. Prehistoric people probably then ate the same plants when they felt sick.

**Drugs in ancient times.** The oldest known written record of drug use is a clay tablet from the ancient Sumerian civilization of the Middle East. This tablet, made in the 2000's B.C., lists about a dozen drug prescriptions. An Egyptian scroll from about 1550 B.C. names more than 800 prescriptions containing about 700 drugs. The ancient Chinese, Greeks, and Romans also used many drugs. In addition, the Romans opened the first pharmacy and wrote the first prescriptions calling for definite amounts of drug ingredients.

Although ancient peoples used many drugs, most of the remedies were useless. Occasionally, people who had taken useless remedies recovered naturally. As a result, they thought the drugs were responsible. However, ancient peoples did discover some effective drugs. The Greeks and Romans, for example, used opium to relieve pain. The Egyptians used castor oil as a laxative, and the Chinese ate liver to cure anaemia.





**The oldest written prescriptions** ever found date from the 2000's B.C. They call mostly for various types of plant remedies.

**Drugs in the Middle Ages.** During the Middle Ages, which lasted from the A.D. 400's to the 1500's, interest in learning and science declined in Europe. As a result, Europeans produced little new information about drugs. But in the Middle East, Arab doctors added new discoveries to the knowledge of drugs they had acquired from the ancient Romans and Chinese. The Arabs later passed on their wealth of knowledge about drugs to Europeans.

Throughout the Middle Ages, the demand for drugs remained high, and pharmacies became increasingly common in Europe and the Arab world. But scientists had not yet learned how the human body functions, what causes infectious disease, or how drugs work. As a result, people continued to take many useless or harmful drugs, in addition to some effective ones.

**Scientific advances.** During the 1500's and 1600's, doctors and scientists made important advances in *pharmacology* (the study of drugs) and in other fields of science. These advances laid the foundation for later revolutionary progress in the development of drugs.

In the early 1500's, the Swiss doctor Philippus Paracelsus pioneered the use of minerals as drugs. He introduced many compounds of lead, mercury, and other minerals in the treatment of various diseases. But further progress in the development of drugs required advances in knowledge of the structure and functioning of the human body.

In 1543, the Belgian doctor Andreas Vesalius, known as the father of anatomy, published the first complete description of the body's structure. His work destroyed many false beliefs about human anatomy. In the early 1600's, the English doctor William Harvey discovered how blood—pumped by the heart—circulates through the body. Later in the 1600's, Anton van Leeuwenhoek, an amateur Dutch scientist, discovered bacteria. He used crude microscopes to study the tiny organisms. But the role of germs as a cause of disease was not established until the 1800's.

**The drug revolution** began about 1800 and has continued to the present. During this period, scientists have discovered hundreds of drugs. They have also discovered the cause of many diseases, determined how

drugs work, and learned much about how the body functions. The practice of medicine has been revolutionized, in large part by the use of drugs. Pharmacology has developed into an important science, and the manufacture of drugs has become a large industry.

In 1796, the English doctor Edward Jenner developed the first successful vaccination in an effort to prevent the often deadly disease smallpox. Jenner vaccinated a boy with pus from blisters on a woman infected with cowpox. The boy then caught cowpox, a minor disease related to smallpox. Jenner later injected smallpox matter into the boy. But the boy did not catch smallpox because his fight with cowpox had made his body *immune* (resistant) to the more dangerous disease. Jenner's discovery led to a search for vaccines against other diseases. This search gradually developed into the science of *immunology*.

Scientists learned how to *isolate* (separate) drugs from plants during the early 1800's. In 1806, morphine became the first of the plant drugs to be isolated. Within a few years, scientists had also isolated quinine, as well as other plant drugs.

In the 1840's, the use of anaesthetics during surgery was introduced by two Americans working independently of each other—Crawford Long, a doctor, and William T. G. Morton, a dentist. Later in the 1800's, the French scientist Louis Pasteur and the German doctor Robert Koch established the *germ theory* of disease. Pasteur proved that germs cause infectious diseases and that the spread of such diseases can be stopped by killing the germs responsible. Koch developed a method for determining which bacteria cause particular diseases.

In the late 1800's, Paul Ehrlich, the German scientist, worked on the immune system and cancerous tumours. His findings were significant in the development of immunity and chemotherapy as important fields in medicine.

The pace of the drug revolution quickened in the 1900's. In fact, most of the major drugs used today have been discovered since 1900. Important developments in

### Drug milestones of the 1900's

- 1903** The first barbiturate, barbital, was introduced.
- 1910** The German scientist Paul Ehrlich introduced *chemotherapy*, a method of treating infectious disease by using chemicals to attack the disease-causing bacteria.
- 1922** A research team led by Frederick Banting, a Canadian doctor, announced the discovery of the hormone insulin, used to treat diabetes.
- 1928** The British scientist Alexander Fleming discovered the first antibiotic, penicillin.
- 1930's** Amphetamines were first used medically.
- 1935** Gerhard Domagk, a German doctor, discovered the first sulpha drug, prontosil.
- 1950's** Scientists developed several important *synthetic* (artificially produced) tranquilizers, which came into widespread use.
- 1960** Birth control pills were introduced.
- 1970's and 1980's** Drug researchers intensified their efforts to find drugs that will help cure cancer and many other diseases not yet conquered by medical science. Recombinant DNA methods were developed and used to produce interferons, hormones, and other drugs.



hormone research followed the first isolation of a hormone in 1898. That year, an American pharmacologist, John J. Abel, isolated the hormone adrenaline. Scientists isolated several other hormones during the next 20 years. Then in the early 1920's, a research team led by Frederick Banting, a Canadian doctor, discovered the hormone insulin. Since that time, this drug has saved the lives of millions of diabetics.

During the early 1900's, Paul Ehrlich, a German scientist, developed a new method of treating infectious diseases. This method, called *chemotherapy*, involves the use of chemicals that attack disease-causing organisms. It is also used to destroy cancer cells. Ehrlich announced the discovery of the first chemotherapeutic drug, arsenphenamine (Salvarsan), in 1910. Ehrlich's work led the way to the later discovery of the germ-fighting antibiotics and sulphonamides.

The first antibiotic, penicillin, was discovered in 1928 by the British scientist Alexander Fleming. A German doctor, Gerhard Domagk, discovered the first sulphonamide, prontosil, in 1935. Scientists soon developed many other antibiotics and sulphonamides. These "wonder drugs" proved to be remarkably effective against a variety of infectious diseases.

Many other important drugs have been discovered since 1900. Barbiturates, which reduce the activity of the nervous system and the muscles, were introduced in 1903. Amphetamines, which stimulate the nervous system, were first used medically in the early 1930's. Scientists developed several tranquilizers in the 1950's, and birth control pills were introduced in the 1960's.

**Growth of the drug industry.** Until about 1800, there were few drug companies. Pharmacists themselves made almost all the drugs they sold. Then two revolutions, one in drugs and the other in industrial development, gave birth to the modern drug industry. The discovery of more and more drugs that required special training and equipment to produce made it increasingly difficult for a pharmacist to prepare drugs. At the same time, the Industrial Revolution in Europe led to the development of manufacturing methods that could be used to mass-produce drugs. As a result, many drug companies were established in Europe, and European companies dominated the world drug market for many years.

The American Civil War (1861-1865)—like the American Revolution—created a great demand for drugs and so furthered the growth of the U.S. pharmaceutical industry. But European companies continued to dominate the world drug market until World War I (1914-1918). During the war, the American pharmaceutical industry expanded rapidly to meet the country's drug needs. The United States soon began to export drugs and became one of the world's leading producers. Over the years, the worldwide demand for drugs has increased rapidly as more and more drugs have been developed. The drug industry has grown with this demand and, through its discoveries, helped create it. Today, the United States leads all countries in drug production.

**Drugs today** benefit us tremendously. They also present us with some of our worst problems and greatest challenges. Drugs help prevent or control many diseases. They also relieve pain and tension and help the body function properly. But the misuse of alcohol, nar-

cotics, and other drugs has led to addiction for millions of people. In addition, the widespread illegal use of drugs has become a major problem.

The challenges that drugs offer lie in the discovery of better medicines for treating all crippling and deadly disorders. In the 1970's and 1980's, researchers increased their efforts to find such drugs. One day, they may develop drugs that slow down the aging process.

**Related articles** in *World Book* include:

#### Drugs that fight bacteria

Antibiotic	Isoniazid	Sulphonamide
Cephalosporin	Penicillin	Tetracycline
Erythromycin	Streptomycin	

#### Drugs that affect the nervous system

Alcohol	Curare	Methamphetamine
Amphetamine	Deadly nightshade	Morphine
Analgesic	Ether	Narcotic
Aspirin	Hallucinogen	Nitrous oxide
Barbiturate	Hashish	Opiate
Beta-blocker	Heroin	Opium
Bromide	Ibuprofen	Procaine
Caffeine	Kola nut	Quinine
Chloroform	Lignocaine	Salicylic acid
Chlorpromazine	LSD	Sedative
Cinchona	Marijuana	Strychnine
Coca	Menthol	Thiopentone sodium
Cocaine	Mescaline	Tranquillizer
Codeine	Metadone	

#### Other kinds of drugs

ACTH	Castor oil	Laetrile
Adrenaline	Coagulant	Laxative
Antabuse	Cortisone	Mercurochrome
Anticoagulant	Cyclosporin	Pancratin
Antihistamine	Digitalis	Psyllium
Antiseptic	Diuretic	Salts
Antitoxin	Emetic	Serum
Arsenic	Eucalyptus oil	Silver nitrate
BCG	Glauber's salt	Smelling salts
Calcium-channel blocker	Hormone	Squill
Camphor	Insulin	Steroid
Cascara sagrada	Iodine	Vitamin
	Iron	

#### Other related articles

Anaesthesia	Depressant	Microencapsulation
Antidote	DES	Pharmacology
Birth control	Drug abuse	Pharmacopoeia
(Methods of birth control)	Enzyme (Uses)	Pharmacy
Chelation therapy	Immune system	Placebo
Chemotherapy	Medicine	Stimulant
	Mental illness	Tragacanth
	(Drug therapy)	

#### Outline

##### I. Kinds of drugs

- A. Drugs that fight bacteria
- B. Drugs that prevent infectious diseases
- C. Drugs that affect the heart and blood vessels
- D. Drugs that affect the nervous system
- E. Other kinds of drugs

##### II. How drugs work

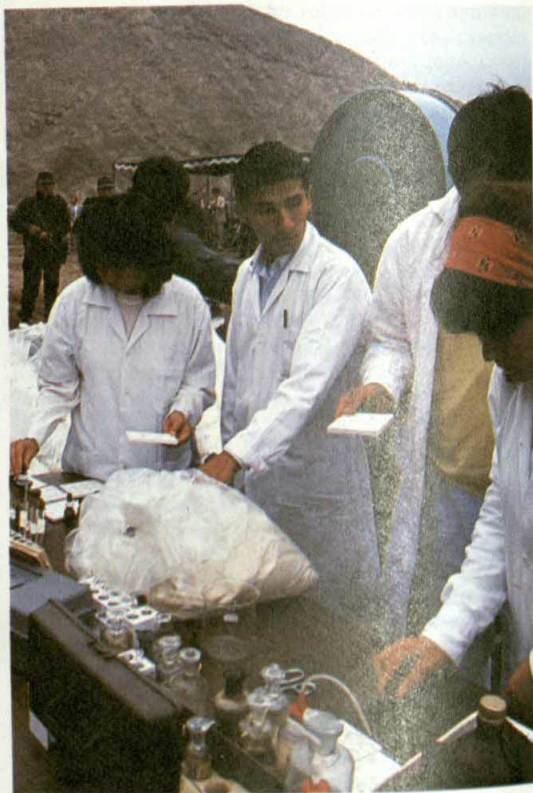
- A. Entrance into the body
- B. Action in the body
- C. Effect on the body
- D. Elimination from the body

##### III. How drugs are produced and sold

- A. Sources of drugs
- B. Research and development
- C. Drug names

##### IV. History





**Drug abuse** can devastate lives. A child born to a cocaine user, *top left*, suffers multiple medical ailments at birth. To fight drug dependence, some users attend treatment programmes, such as group therapy, *above left*. Governments combat drug smuggling by checking shipments crossing national borders for the presence of illegal drugs, *above right*.

## Drug abuse

**Drug abuse** is the nonmedical use of a drug that interferes with a healthy and productive life. Drug abuse occurs at all economic levels of society, from the wealthy to the impoverished, and among young people as well as adults. Any drug may be abused, including alcohol and medications prescribed by a doctor.

After continued use of certain drugs, some people develop a condition called *drug dependence*. Drug dependence can be psychological, physical, or both. A person with a psychological dependence craves a drug for the feeling of well-being it might provide. A person with a physical dependence continues drug use chiefly to avoid the physical illness that results when drug use stops. The need for a drug may become so overpowering that nothing matters except getting more.

Many people begin and continue to use drugs because they want a pleasurable change in their state of mind. Unfortunately, drugs only change the brain's perception of difficulties and problems. When a drug wears off, the user's real problems nearly always remain.

Many harmful effects often accompany drug use. These effects include failure to achieve personal or family goals, undesirable personality changes, physical illness, and death.

Besides the personal damage the drug user suffers, a person's drug use can have a devastating effect on others. Many drug users turn to crime or prostitution to support their habit. Many traffic deaths and injuries are caused by people under the influence of alcohol or other drugs. Drug abuse also damages families and other personal relationships.

### Types of drug abuse

**Abuse of legal drugs.** Some of the most commonly abused drugs can be purchased legally. They include (1) alcoholic beverages, (2) tobacco, (3) inhalants, and (4) prescription drugs.

**Alcoholic beverages** are made chiefly from grains or fruit and contain ethyl alcohol, one of the most commonly abused drugs in the world. Alcohol is a *depressant*—that is, it lowers the activity of the central nervous system. It also interferes with thinking, concentration, and movement. Heavy use of alcohol can lead to death. Even a single episode of excessive drinking can cause coma and death. Some people develop a physical dependence on alcohol, and overcoming that dependence may be extremely difficult. See **Alcoholism**.

**Tobacco** is a plant native to North and South America, whose leaves are made into smoking tobacco, chewing tobacco, and snuff. Tobacco contains a substance called *nicotine*. Nicotine is a *stimulant*, a drug



that raises activity of the central nervous system. In addition to nicotine, tobacco smoke contains carbon monoxide and substances called *tars*. The chemicals that make up the tars can cause lung cancer. Tobacco use contributes to heart disease and other health problems. It can become a habit that many users have difficulty breaking. See **Smoking**.

**Inhalants** are substances that give off fumes inhaled for their intoxicating effects. They include certain glues, nail polish, petrol, and aerosol sprays. In some instances, the effect of these substances results from their fumes' taking the place of oxygen in the lungs. The reduced flow of oxygen to the brain creates an intoxicating effect. Inhalants can make the user relaxed, restless, uncoordinated, and sometimes delirious. Some fumes result in lung damage, brain damage, and coma. Some also can cause death when they coat the lungs' surface and prevent the absorption of oxygen.

**Prescription drugs** can be obtained legally only with a doctor's prescription. Commonly abused prescription drugs include tranquilizers, barbiturates, stimulants called *amphetamines*, and *analgesics* (pain relievers). Many prescription drugs are powerful, and some create physical dependence. For more information on these drugs, see the *World Book* articles on **Tranquillizer**, **Barbiturate**, **Amphetamine**, and **Analgesic**.

**Steroids** are a special type of prescription drug used medically for a variety of purposes. Some athletes take *anabolic steroids* because, in certain cases, the drugs help increase muscle size and strength. Some doctors believe anabolic steroids may cause aggressive behavior and lead to liver damage. See **Steroid**.

**Abuse of illegal drugs.** Many abused drugs are illegal—that is, their possession and sale are forbidden by law. Illegal drugs include (1) cocaine, (2) marijuana, (3) heroin and other opiates, (4) hallucinogens, and (5) designer drugs. In some countries, some of these drugs can be obtained legally with a prescription.

**Cocaine** is a powerful stimulant made from the leaves of the coca shrub, a plant native to the Andean region of South America. Most users eat or *snort* (sniff) a powdered form of the drug, or inject a solution of cocaine and water. Some people also smoke a form of cocaine called *crack*. People easily develop a compulsive desire for cocaine, and many have great difficulty stopping the use of this drug.

**Crack** is a form of cocaine usually smoked in a potent crystal form. It produces stronger, briefer effects than other forms of cocaine because the body absorbs it faster. Crack cocaine is considered to be highly addictive.

**Ecstasy**, or MDMA, is classed as a hallucinogenic drug manufactured in laboratories. It produces some of the effects of amphetamines combined with LSD-like hallucinogenic experiences. Ecstasy users swallow the drug in tablet or capsule form. Research suggests that it can permanently damage brain cells.

**Marijuana** is the common name for hemp, a tall plant that grows easily in most parts of the world. It contains a potent drug called *tetrahydrocannabinol* (THC). People usually smoke the dried leaves and flowers of the plant in cigarettes or pipes. Some may mix marijuana with food and beverages. The thick, sticky resin of the plant, called *hashish*, can be eaten or smoked.

**Heroin and other opiates** are made from the sap of the opium poppy. *Opium*, the dried sap of the poppy's seed pods, contains a potent narcotic called *morphine*. Some people smoke or eat opium, seeking pleasant effects from morphine. Doctors use morphine to relieve severe pain in patients. *Codeine*, a less potent opiate, relieves coughs and mild pain. Heroin is a highly addictive drug made from morphine. People use heroin by eating or snorting it, or by injecting it.

**Hallucinogens** include such naturally occurring drugs as *mescaline*, produced within the peyote cactus, and such substances as LSD (lysergic acid diethylamide), manufactured in laboratories. Hallucinogens affect the senses, emotions, and reasoning, often producing delusions or visions. The hallucinogen *PCP* (phencyclidine) may cause violent outbursts.

**Designer drugs**, created in laboratories, are variations on existing illegal drugs. Originally, they were "designed" to vary slightly in chemical composition from the definition of existing illegal drugs so that they could be considered legal substances. Many designer drugs are of poor quality, and they sometimes contain dangerous chemicals.

## Why people abuse drugs

Young people begin using drugs for various reasons. Some experiment with drugs because their friends use them. Many young people find it difficult to resist *peer pressure* (the influence of people their own age). Also, young people often have a sense of *invulnerability*—that is, that death or other severe consequences of drug use will not affect them personally. Users of tobacco and alcohol may be attempting to appear grown-up by imitating their parents or other adults who smoke or drink. See **Adolescent** (The use of drugs).

Adults may begin using drugs for some of the same reasons as young people. In addition, the stress of life, job, and family pressures may lead people to seek relief in drugs. People also may use drugs for a surge of energy or to help them relax. Others may use drugs out of curiosity, for a thrill, or to rebel. Regardless of why drug use begins, many people continue the practice because they become dependent on the drug.

## Effects of drug abuse

**Effects on the individual.** Both legal and illegal drugs have a range of potentially harmful effects. For example, alcohol can damage the liver, brain, and heart. Cocaine can cause high blood pressure, leading to a burst blood vessel in the brain and a stroke. Injecting drugs into the body with contaminated needles can lead to blood poisoning, which may destroy the heart valves and result in death. Sharing needles and syringes with a person who has hepatitis or AIDS can give a user those diseases. Constant drug use also causes malnutrition, particularly in heavy drinkers, who tend to miss meals and suffer from lack of vitamins. Use of illegal drugs may lead to overdose or death because their strength is unknown, and some contain toxic impurities.

Frequent drug users may turn to crime to meet the increasing expense of their habit. Continued drug use may cause personality changes. The user may become hyperactive or withdrawn. Some users lose interest in school, work, or family life.



## Some commonly abused drugs

Name	What they do	Some possible immediate health effects	Some possible long-term effects
<b>Stimulants</b> Amphetamines	Speed up physical and mental processes, boost energy, create sense of excitement.	Appetite loss, blurred vision, dizziness, sweating, sleeplessness, trembling, anxiety, hallucinations.	Malnutrition, depression, memory impairment, mental illness, stroke, heart failure.
Cocaine and crack	Speed up physical and mental processes, create sense of heightened energy and confidence.	Rapid heartbeat, depression, sleeplessness, muscle spasms, convulsions, loss of sexual desire, impaired judgment, extreme suspiciousness, violence.	Damage to nasal lining, heart attack, stroke, hepatitis or AIDS (if injected). Risk of fatal overdose. If used in pregnancy, danger of miscarriage and risk of birth defects.
Tobacco products	Speed up physical and mental processes, decrease appetite, lessen fatigue.	Nausea, throat irritation, shortness of breath, vomiting, increased blood pressure and heartbeat.	Bronchitis, emphysema, lung cancer, heart attack, stroke. If used in pregnancy, can cause miscarriage, or birth defects.
<b>Depressants</b> Alcoholic beverages	Slow down central nervous system, produce intoxication and drowsiness.	Mental confusion, slurred speech, impaired judgment, poor coordination, violence.	Physical dependence, memory impairment, hallucinations, violent trembling, liver damage, paralysis, death. If used in pregnancy, increased risk of birth defects.
Barbiturates	Produce mild intoxication, drowsiness and lethargy. Decrease alertness.	Drowsiness, poor coordination, slurred speech, slowed breathing, weak and rapid heartbeat, impaired judgment, confusion, irritability.	Physical dependence, coma. Risk of fatal overdose. If used in pregnancy, can cause birth defects. Sudden withdrawal can cause death.
Tranquillizers	Slow down the central nervous system and relax muscles. Decrease alertness.	Slurred speech, drowsiness, stupor. Impaired judgment.	Physical and psychological dependence.
<b>Marijuana and hashish</b>	Relax the mind and body, distort perceptions, alter mood, impair coordination.	Faster heartbeat and pulse, impaired perception and reactions, possible hallucinations, panic attacks, decreased motivation.	Impaired memory and coordination, bronchitis. If used in pregnancy, babies may have lower birth weight and slower growth rate.
<b>Heroin, morphine, and codeine</b>	Relax central nervous system, relieve pain, produce sense of well-being.	Restlessness, nausea, vomiting, slowed breathing, lethargy, mood swings, sweating.	Physical dependence, malnutrition, lower immunity, infections of the heart lining and valves, liver disease, hepatitis or AIDS (from contaminated needles), and fatal overdoses.
<b>Hallucinogens</b> LSD, PCP, and mescaline	Alter perceptions and produce hallucinations, which may be frightening or pleasurable.	Increased heart rate, nausea, sweating and trembling on LSD. PCP can produce stupor and delusions of great strength and invulnerability. Mescaline can produce vomiting, fever, increased blood pressure and heart rate.	LSD may trigger disturbing flashbacks. PCP can cause coma, convulsions, heart and lung failure. Effects of mescaline unknown.

Associated with many drugs are two effects known as *tolerance* and *withdrawal* that often contribute to continued drug use. Tolerance is a state of resistance to the effects of a drug. A person who develops a tolerance must take more and more of a drug to achieve its original effect. In this way, occasional drug users can become frequent users. Withdrawal is the reaction of the body when regular drug use is stopped. The symptoms of withdrawal can range from headaches and muscle cramps lasting a few days to death, depending on the drug and the extent of use. Some people continue to use drugs only to prevent withdrawal symptoms.

The warning signs of drug abuse are varied. Most abused drugs strongly influence a person's behaviour. For example, excessive use of alcohol or sleeping pills causes slurred speech and drowsiness. People who use cocaine become restless and talkative. Parents may notice money and household items disappearing as their children seek money to buy drugs. Employers might find workers functioning poorly.

**Effects on family, friends, and work.** Some users spend so much time under the influence of drugs or thinking about getting drugs that they neglect their family, friends, and work. In some cases, their actions harm the people closest to them. Pregnant women who take drugs can cause harm to their unborn children. All drug users risk injury or death to themselves and others if they drive a vehicle under the influence of a drug.

Some people help conceal and make up for a user's destructive actions. They pay a user's debts, supply money that can be used for drugs, and in other ways make it possible for drug use to continue. These people are called *codependents*. Some codependents do not realize they are supporting the habit. Others may say they oppose drug use, but they find themselves unable to stop assisting the user's drug habit. Some codependents fear losing the user's affections. Others may fear the legal consequences of refusing the user. For example, if rent goes unpaid, a user might be evicted.

**Effects on society.** Drug users may resort to theft,



prostitution, or selling drugs to pay for their drug habits. Drug users in the transportation industry, such as bus drivers and air traffic controllers, risk endangering the public. Factory and office workers using drugs perform inefficiently and make mistakes. These inefficiencies and errors result in higher costs for products.

### Treatment of drug abuse

Some doctors use medication to treat drug dependence. Such medication relieves craving or blocks the effect of habit-forming drugs. Doctors often use *methadone*, a drug with effects similar to opiates, to relieve an addict's craving for heroin during withdrawal. Although methadone is addictive, many doctors believe its use in the treatment of opiate addicts can be beneficial. *Disulfiram*, also known as *Antabuse*, is a drug used to treat alcoholism. It makes the user suffer flulike symptoms for several hours whenever alcohol is consumed. Nicotine skin patches can relieve a smoker's craving for cigarettes. See **Methadone; Disulfiram**.

Many professionals who treat drug dependence believe that users can profit from treatment in groups of drug users. In such groups, drug abusers share experiences and learn from one another. One organization that uses such treatment, Alcoholics Anonymous (A.A.), has helped many people dependent on alcohol. Other counselling methods include individual psychotherapy and treatment communities, where members must follow strict rules of conduct.

*Detoxification* is a treatment used to eliminate a person's physical dependence on a drug by eliminating the drug from the body. One method involves decreasing the daily dose of a drug gradually over a period of weeks to reduce the severity of withdrawal illness. Effective detoxification methods include counselling and other support to help users fight craving and solve the problems that first led them to drugs.

Treatment for drug abuse is not always successful. Some people must fight strong cravings for years after they stop using drugs. The success of the treatment often depends on the person's desire for cure. Pressure from the family and employer often motivates the user to seek treatment and stay off drugs.

### Combating drug abuse

**Reducing supply.** In the developed countries, the vast profits from the drug market attract drug suppliers from many parts of the world. To discourage drug smuggling and dealing, known as *drug trafficking*, most countries set severe punishment for anyone convicted of those crimes.

Countries also attempt to block the supply of drugs at their borders. Coast guards patrol national shores to prevent illegal shipments of cocaine and narcotics from entering the countries. The police in many countries cooperate to arrest those who distribute, finance, and process illegal drugs.

Despite efforts to reduce the supply of drugs, large quantities still enter the market from Latin America and Asia.

**The legalization debate.** The problem of drug abuse has persisted worldwide despite vast sums spent each year trying to stop the trade. In addition, drug traffickers have continued to commit violent crimes and

make large profits. Because efforts to reduce drug abuse and drug-related crime have not shown dramatic results, some people have suggested that drugs be legalized.

Supporters of legalization believe laws against making and selling drugs should be overturned. They argue that if drugs were legally available at low prices, drug dealers would go out of business and much drug-related crime would end. In addition, the money spent on law enforcement could be devoted to educating and persuading people how to avoid the misuse of drugs, and to treat those who are dependent on drugs.

Instead of legalization, some people suggest changing the laws so that possession of small amounts of drugs would not be treated as a criminal offence. Such changes, called *decriminalization*, would make personal use of drugs legal or subject only to a small fine. The greatest efforts to arrest drug traffickers would continue, however.

People against legalization fear that the low price and availability of legal drugs would encourage the use of dangerous substances. They also fear that the alternative, setting a high price on drugs to discourage people from using them, would sustain an illegal market of lower-priced drugs.

### Related articles in *World Book* include:

Adolescent (The use of drugs)	Heroin
Alcoholism	LSD
Amphetamine	Marijuana
Barbiturate	Mescaline
Cocaine	Methadone
Codeine	Methamphetamine
Depressant	Morphine
Disulfiram	Narcotic
Drug	Opium
Hallucinogen	Smoking
Hashish	Stimulant

### Outline

#### I. Types of drug abuse

- A. Abuse of legal drugs
- B. Abuse of illegal drugs

#### II. Why people abuse drugs

#### III. Effects of drug abuse

- A. Effects on the individual
- B. Effects on family, friends, and work
- C. Effects on society



**Habit-forming drugs** were contained in certain nonprescription remedies in the United States in the late 1800's. Many people developed a drug dependency from these medicines.



## IV. Treatment of drug abuse

## V. Combating drug abuse

- A. Reducing supply      B. The legalization debate

## Questions

What is a *codependent*?  
 Why do adolescents begin using drugs?  
 What is *drug tolerance*? *Drug withdrawal*?  
 Why do some people believe that drugs should be legalized?  
 What is drug dependence?  
 How may drug use lead to criminal activity?  
 In what occupations are many workers tested for drug use?  
 How may a drug user's habits affect his or her family?  
 What are inhalants?  
 What are the major treatment forms for drug abuse?

**Drug addiction.** See **Drug abuse.**

**Drug therapy.** See **Chemotherapy; Mental illness (Drug therapy).**

**Druids** were the priestly, learned class among the Celts, a people of ancient Europe. The Druids were judges and lawmakers as well as priests. They led religious ceremonies, settled legal disputes, and served as leaders and advisers to their people.

Druidism, the religion of the Druids, involved the worship of many gods. The Druids regarded mistletoe and oak as sacred. They believed the soul was immortal and entered a new body after death. The Druids killed animals and possibly even human beings as sacrifices. They studied the flights of birds and the remains of sacrificed animals to foretell the future. The Romans, who conquered much of Europe between about 300 B.C. and about A.D. 100, tried to stop druidism. The religion finally died out after the Celts became Christians in the 400's and 500's.

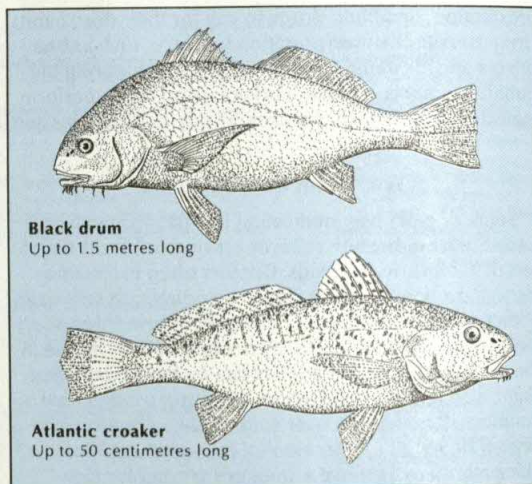
During the 1600's, the descendants of the Celts became interested in their Druidic heritage. Today, several groups in Great Britain and Ireland practise what they believe to be ancient Druidism. They hold Druidic festivals at the beginning of spring, summer, autumn, and winter. A major celebration takes place at Stonehenge, a monument near Salisbury, England, that the Druids are said to have used. In Wales, festivals of music and poetry called *eisteddfods* include Druidic rites.

See also *Eisteddfod; Halloween* (The Celtic festival).

**Drum** is any member of about 200 species of fish. Some drums are also called *croakers*. Drums get their name from the sound some of them make. These drums repeatedly tighten certain muscles on their swim bladder in the abdomen to produce vibrations that sound like drumming. Many kinds of drums live in warm, shallow ocean water near the shores of most continents. Some spend part of their early life in freshwater rivers. They also live in bays where fresh and salt water are mixed. But only one species, the *freshwater drum*, spends its entire life in fresh water. The freshwater drum lives in large lakes and rivers from Canada to Central America.

Drums range in size from species that weigh about 0.45 kilogram to those that weigh more than 45 kilograms. The *totuava*, which lives in the Gulf of California, is the heaviest. This rare fish weighs as much as 100 kilograms and measures up to 2 metres long. Most drums have a scaly head; a blunt, rounded nose; and two upper fins separated by a notch.

Many drums, including the *red drum* and the *white croaker*, have teeth only in the rear of their mouth.



Several kinds of drums are popular seafood. Commercial fishing crews catch black drum and Atlantic croakers off the Atlantic Coast of North America. These fish have firm, white flesh.

These flat, grinding teeth enable the drums to eat clams, crabs, shrimp, and other shellfish that they find along the ocean floor. Other drums, including the *spotted seatrout* and the *weakfish*, have sharp front teeth that allow them to feed on such free-swimming animals as shrimp, squid, and small fish (see *Weakfish*).

Two drums of the tropical Atlantic, the *jackknife-fish* and the *high-hat*, are favourites of aquarium owners. These small fish have an extremely high fin on their back, and interesting black-and-white markings.

**Scientific classification.** Drums make up the drum family, Sciaenidae.

**Drum** is the oldest musical instrument. It is a member of the percussion family, which consists of instruments that are played by striking them with the hand, sticks, or other objects. Drums have also been used for various nonmusical purposes. For example, people of many cultures have used drums to communicate over long distances.

The *shell* (body) of a drum may be shaped like an open cylinder or a kettle. A thin covering called a *drum-head* is stretched tightly across the opening. Drumheads may be made of either calfskin or plastic. A cylinder-shaped drum generally has two drumheads. A kettle-shaped instrument has one.

A musician strikes the drumhead with sticks, with mallets, or with the hand to create vibrations that produce a sound. This sound *resonates* (increases) inside the shell of the drum.

The three most popular types of drums are the *snare drum*, the *bass drum*, and the *timpani*. Only the timpani can produce definite musical notes. The other types are used primarily as rhythm instruments.

The snare drum consists of a metal or wooden cylinder with a drumhead covering each opening. The drumhead used for playing is called the *batter head*. The opposite one is called the *snare head*. About 12 gut or wire strings called *snares* stretch across the snare head. A drummer strikes the batter head with two wooden



sticks. The snares vibrate against the snare head, producing a full, crisp sound.

The bass drum resembles a large snare drum. The drumhead used for playing is called the *beating head*, and the opposite one is called the *resonating head*.

The timpani are played in pairs or in groups of four. The drum is often called a *kettledrum*. It consists of a large copper or fibreglass shell with a single drumhead. A pedal mechanism enables the player to tune the drum to different pitches. Timpani produce a deep, resounding tone achieved by striking the drumhead with mallets. Different tone colours may be obtained by using a variety of mallets made of soft felt, hard felt, or wood.

See also **Bongo drums**; **Conga drum**; **Tambourine**; **Tom-tom**.

**Drumfish.** See **Drum**.

**Drumlin.** See **Glacier** (How glaciers shape the land).

**Drummond, Stanley** (1885-1943), an Australian Methodist missionary, gained distinction for his social welfare work, especially for children. He spent many years working in the far western regions of New South Wales and southern Queensland. He became convinced that children living in these regions needed greater medical attention. In 1924, Drummond began taking children from these regions to Manly, in Sydney, for summer holidays by the sea. This scheme led to the establishment of the Drummond Far West Home at Manly,

where sick country children receive specialized medical attention. A camp at Manly provides 3 weeks' annual holiday for children between 10 and 12 years of age who have never seen the sea and live more than 480 kilometres from Sydney. Drummond was born at Atunga, in New South Wales.

**Drummond of Hawthornden, William** (1585-1649), was one of the few Scottish poets of his time who chose to write in English, rather than in Gaelic. He wrote a great amount of poetry and an important prose work, *The Cypress Grove*. He was born at Hawthornden manor, near Edinburgh, and educated at Edinburgh University. He travelled widely in England and on the continent of Europe, and was acquainted with many of the leading European literary figures of his time. He inherited the estate at Hawthornden in 1610 and lived quietly there much of the rest of his life.

**Drunkennes.** See **Alcoholism**.

**Drupe** is a fleshy fruit that has a single seed surrounded by a hard covering or *stone*. The pulp of a drupe is not divided into segments like the pulp of an orange. The whole drupe is usually covered with a thin skin. Drupes include the olive, plum, cherry, and peach. See also **Fruit** (illustration: Drupes).

**Drury Lane**, in London, connects High Holborn with Aldwych. It is famous for the Theatre Royal, commonly called the *Drury Lane Theatre*.

### Some common types of drums

Drums are percussion instruments that provide rhythmic accompaniment in many kinds of music. A drum set consists of a number of drums of different sizes and types, along with cymbals. Most drum sets are used in popular music. Musicians usually play bongo drums in Latin-American music. Timpani are among the largest drums and are generally played in symphony orchestras.



A drum set



Bongo drums



Timpani



The present theatre actually faces Catherine Street and backs on to Drury Lane. It is the fourth of the same name on this site. Thomas Killigrew built the first theatre under a charter granted by Charles II in 1662. Nell Gwynne may have been born in an alley off Drury Lane. She later became an actress in the Theatre Royal and mistress to Charles II. Sir Christopher Wren rebuilt the theatre in 1674 after a fire. Robert Adam reconstructed the theatre in 1775 for David Garrick. This building was demolished in 1791 and a new theatre built. It was destroyed by fire in 1809. Benjamin Wyatt rebuilt the theatre, and the exterior of his building is still standing.

Many famous theatrical people have been connected with Drury Lane Theatre. Colley Cibber, David Garrick, Edmund Kean, Sir Henry Irving, Sarah Siddons, and Dame Ellen Terry all acted there. Richard Sheridan was one famous manager, and John Dryden was its principal playwright for some years.

In recent times, its most famous production has been the musical *My Fair Lady*, which opened in 1958, and had 2,281 performances.

**Druses** are an Arabic-speaking people of the Middle East. There are more than 500,000 Druses, who are also known as the *Druze* or *Druzes*. About half of them live in the Hauran districts of Syria. Most of the rest live in Lebanon and about 40,000 are in Israel. Some Druses have emigrated to the United States and Canada.

The Druses practise a secret religion related to Islam. Al-Hakim, a ruler of Egypt during the A.D. 1000's, founded the religion. He declared that he was God. When he died, Ismail al-Darazi, one of his followers, spread the religion to the people in the Syrian mountains. The name *Druze* probably comes from *Darazi*.

The Druses in Lebanon had little political representation before the 1990's. They played a key role in fighting that broke out against the Lebanese government in the early 1980's. In 1990 and 1991, they gained representation in Lebanon's government in accordance with a 1989 peace agreement.

**Dry, Sir Richard** (1815-1869), the first locally born premier of Tasmania, Australia, held office from 1866 to 1869. Dry was born near Launceston. He was nominated to the Legislative Council in 1844. A strong opponent of the transportation of convicts, Dry resigned over this issue in 1845. He accepted reappointment to the council in 1847 and served as its speaker from 1851 to 1854.

**Dry cell.** See **Battery** (Kinds of batteries).

**Dry cleaning** is a process that removes dirt and stains from fabrics. Dry cleaning uses little or no water, but the process is never dry. It involves the use of liquid *solvents* (substances that dissolve other substances).

Dry-cleaning plants clean items that may shrink, fade, or be damaged in some other way if washed in water. These items include certain clothing, including garments made of wool or silk, and household objects such as curtains and bedspreads.

Some materials should not be dry cleaned. For example, dry cleaning may cause vinyl or artificial leather to crack or split.

**How clothes are dry cleaned.** Workers begin the process by sorting the clothes according to colour and type of fabric. Workers in a spotting department then *prespot* garments by brushing or spraying stains and spots with special chemicals. These chemicals loosen or

remove spots that might otherwise become permanent later in the process.

The clothes are then put into a large washing machine. The dry-cleaning machine has a rotating drum filled with a liquid synthetic solvent instead of water. Workers usually add a dry-cleaning detergent to the solvent to help remove water-soluble spots. As the drum rotates, the solvent circulates through the garments.

After the cleaning cycle, the solvent drains from the machine. The drum spins rapidly to remove most of the solvent from the clothes. Unlike water used in home washers, the solvent in the dry-cleaning machine is filtered and reused. Workers then tumble dry the clothes, usually in the same machine.

Next, a person called a *spotter* examines whatever spots remain. He or she determines which spots can be removed without damage to the fabric or the dye. The spotter then wets these spots with a *steam gun*, a nozzle that sprays a jet of water vapour. Finally, the spotter treats the spots with chemicals.

From the spotting department, the garments go to a presser or finisher. This worker uses presses, hand irons, and steaming equipment to remove wrinkles and restore the shape and texture of the garments.

Self-service, coin-operated dry-cleaning machines clean and dry clothes automatically. Self-service dry cleaning costs less than the professional process, but some garments require professional care.

**Dry dock** is a dock in which a vessel can lie out of the water while repairs are being made below its water line (see **Dock**). The two chief kinds of dry docks are graving docks and floating docks.

**Graving docks** are used chiefly to repair large ships in shipyards. *Graving* was a term used in the days of wooden ships to mean cleaning a vessel's bottom and coating it with tar. A graving dock looks like a huge, concrete bath sunk into the ground. One end of the dock opens onto a harbour, river, or other waterway. When a ship enters the dock, shipyard workers place a huge floating or sliding *caisson*, or gate, against the open end. Pumps suck the water out and the vessel slowly sinks. Its *keel*, or bottom, comes to rest on wooden blocks placed on the floor of the dock. *Spars*, or long pieces of wood wedged between the ship and the sides of the dock, also help support the vessel. When repairs are completed, workers flood the dock



**Dry docks** at the Puget Sound Naval Shipyard in Bremerton, Washington, U.S.A., are used to repair naval vessels.



until the water reaches the same level as the water outside the gate. It is opened and the ship leaves.

**Floating docks** can be self-propelled or towed from place to place. They are important in war to repair ships in forward battle areas. A floating dock looks like a shoebox with the top and ends removed. Some types are built in U-shaped sections that can be assembled to make one large dock. The *hull*, or bottom, and *wing-walls*, or sides, of a floating dock contain compartments. Water enters these compartments, making the dock sink low enough to allow a ship to enter. Pumps then suck the water out and the dock rises, lifting the ship out of the water. Wooden blocks and spars similar to those used on graving docks help support the vessel. When repairs are completed, the compartments are flooded again until the dock sinks enough to allow the ship to float.

**Dry farming** is a process of growing crops in semiarid regions without irrigation. Semiarid regions receive little rainfall during the crop-growing season. Therefore, farmers in these regions try to increase the amount of water that soaks into the soil during rainy or snowy periods. During the growing season, the crops absorb water stored in the soil.

Dry farming includes various practices that help increase soil moisture. Many farmers leave part of their land *fallow* (unplanted) each year. The fallow soil stores moisture for the following year's crop. Instead of ploughing the land, the farmer tills the soil about 8 centimetres deep. This technique, called *shallow cultivation*, kills weeds, which absorb moisture from the soil. It also exposes less soil to the air than ploughing does and so reduces the amount of water that evaporates from the soil. Some farmers control weeds by applying chemical *herbicides*, rather than by tilling the soil.

Another dry-farming technique is *contour ploughing*, which is practised on sloping land. In contour ploughing, the farmer ploughs across a slope, rather than up and down. The ploughed soil forms furrows, which prevent rainwater from running down the slope. Thus, the water stays on the slope and filters into the ground.

After harvesting a crop, many farmers leave dead stalks and other plant wastes on the fields as a covering during the winter. The wastes create an uneven surface, to which snow sticks easily. These waste materials prevent some snow from being blown away by the wind. After the snow melts and soaks into the ground, the covering helps keep the moisture in the soil.

Only certain hardy crops, such as barley, sorghum, and wheat, can be grown by dry-farming methods. Even so, farmers must plant these crops as early as possible in the growing season so that the plants mature before the weather becomes too hot and dry.

Dry farming is practised in semiarid regions of many countries, including Australia, Canada, China, Russia, and the United States. Researchers have improved many dry-farming techniques and have developed new crop varieties that need little water. These improvements have increased food production in dry-farming regions.

**Dry ice** is solid carbon dioxide. The name *dry ice* refers to the fact that the substance changes from a solid to a gas without first becoming liquid. Because of this property, dry ice is widely used in industry to refrigerate food, medicine, and other materials that would be

damaged by the melting of ordinary ice. Chemists use a mixture of dry ice and acetone or isopropyl alcohol to cool chemicals during certain reactions.

Dry ice is made in snowlike flakes or in blocks. Flakes are produced by cooling and compressing liquid or gaseous carbon dioxide. Blocks are formed by further compression of the flakes.

The chemical formula for dry ice is  $\text{CO}_2$ . Dry ice has a temperature of  $-78.5^\circ\text{C}$ , which is much colder than the temperature of ordinary ice. For this reason, special care must be taken when handling dry ice to avoid the risk of frostbite.

See also **Food, Frozen** (Dry-ice freezing); **Rainmaking** (Rainmaking methods).

**Dry rot.** See **Rot**.

**Dry wall.** See **Wallboard**.

**Dryden, John** (1631-1700), was the outstanding English writer of the *Restoration period* (about 1660 to 1700). He excelled as a poet, dramatist, and literary critic. Dryden believed that the individual is part of a society that has its roots in ancient Greece and Rome. He also believed that literature and the arts have value as civilizing forces. As a result, his writings deal with large social, political, and humanistic issues.

Dryden was born in Northamptonshire, and studied at Trinity College, Cambridge. He began writing after moving to London in the late 1650s. Dryden wrote only poetry at first, but later began writing plays to make a living. His finest play is *All for Love* (1677), an adaptation of Shakespeare's *Antony and Cleopatra*. Dryden simplified Shakespeare's story and concentrated on the tragic passions of the two famous lovers. *The Conquest of Granada* (1670, 1671), an imposing heroic drama, and *Mariage à la Mode* (1672), a gay, sophisticated comedy, rank among the best of Dryden's plays.

Dryden's best poems sprang from his involvement with political controversies of his time. In 1668, Dryden was appointed poet laureate, and in 1670 he received another government position as royal historiographer. He became involved in political disputes that developed between King Charles II and Parliament. A loyal Tory, he was firmly on the king's side against the Whigs. *Absalom and Achitophel* (1681), Dryden's most famous poem, is a brilliant, extremely witty satire against the king's enemies. *The Medal* (1682) is an even more biting attack on the Whigs.

Dryden also wrote to defend his religious faith. *Religio Laici* (1682) is a poem that defends the Church of England against its enemies. Dryden became a Roman Catholic about 1686, and wrote *The Hind and the Panther* (1687) in defence of Catholicism. In *MacFlecknoe* (published in 1682 but written about 1678), he used humorous verse to attack a literary foe, Thomas Shadwell.

In 1688, King James II, a Catholic, lost his throne to William and Mary, who were Protestants. Dryden refused to swear allegiance to the new rulers, and he lost his government positions. He wrote a few plays and poems after 1688, but spent much of his time translating works to support himself. Dryden's most famous translations are the poems of Virgil (1697). "Alexander's Feast" (1697) is his best poem of the period.

Dryden also wrote much literary criticism. His best works include *An Essay of Dramatic Poesy* (1668), which expresses his admiration for Shakespeare; and his pref-



ace to a collection of fables published in 1700, in which he praised Chaucer.

See also **English literature** (Restoration literature).

**Drysdale, Sir Russell** (1912-1981), an Australian painter, became known for his outback landscapes. But his depictions of still life, interiors, and studies of nudes are equally impressive.

George Russell Drysdale was born at Bognor Regis in England and moved to Australia with his family in 1923. After leaving Geelong Grammar School, he became a jackeroo (cow hand) and later managed his parents' Riverina property. Drysdale met his early teacher, George Bell, while in Melbourne hospital. Bell helped Drysdale develop his natural aptitude for drawing.

Drysdale studied in London and Paris in 1938 and 1939. He was rejected for war service because he was blind in one eye. During the early 1940's, he began to produce a series of drawings and paintings on the themes of the drought, isolation, and devastation in Australia's outback country in the spirit of such wartime British artists as Henry Moore, Graham Sutherland, and John Piper. His work led to what later became known as *the Antipodean School* in Australian art history.

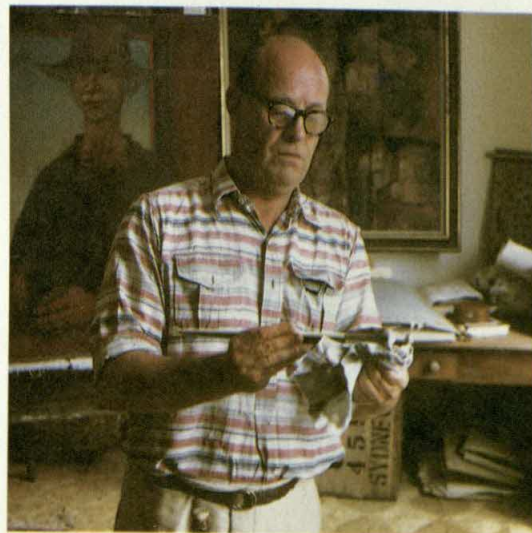
See also **Australian art** (picture).

**DT's.** See **Delirium tremens**.

**Dual Monarchy.** See **Austria-Hungary**.

**Duarte, José Napoleón** (1926-1990), took office as the elected president of El Salvador on June 1, 1984. He had served as appointed president of a military junta from 1980 to 1982. During his presidency, Duarte could not end a civil war that had lasted 10 years and had resulted in more than 60,000 deaths.

Duarte was born in San Salvador. In 1948, he graduated from the University of Notre Dame in Indiana, U.S.A. In 1960, Duarte helped organize the Christian Democratic Party in El Salvador. He served as mayor of San Salvador from 1964 to 1970. As mayor, he organized neighbourhood groups to build or repair schools and health facilities, and to establish parks.



**Sir Russell Drysdale** is known for his paintings of the loneliness and harshness of the Australian outback.

Duarte ran for president in 1972. Early election returns showed him in the lead, but the ruling government altered the final results to show its own candidate as the winner.

Duarte went into exile in Venezuela after some of his followers tried to overthrow the government and failed. He returned to El Salvador in 1979, after a military junta seized power.

See also **El Salvador** (Recent developments).

**Du Barry, Madame** (1746-1793), was the beautiful country girl who became the mistress of King Louis XV of France (see **Louis [XV]**). She had little education. Instead, the beauty of this blue-eyed blonde and her pleasant manner were her greatest assets. She was not meddlesome, but jealous rivals and the king's ministers hated her so much that she had to use her influence upon the king in self-defence. By the time Louis XV died in 1774, she counted many friends at court.

She was born in Champagne, France. Her real name was Marie Jeanne Bécu. She first worked in a hat shop in Paris, but before long she became the mistress of the Comte Jean du Barry. She met Louis in du Barry's gambling rooms. She married William du Barry, Jean's brother, to acquire the title Countess du Barry and thus gain enough social rank to be presented at court. This formality was required before she could become Louis XV's official mistress. In 1793, the French republicans accused her of aiding enemies of the French state. She was dragged to the guillotine and put to death just five weeks after Marie Antoinette's execution.

**Dubbing.** See **Film Industry** (Mixing the sound).

**Dubbo** (pop. 33,864) is a city in New South Wales, Australia, about 420 kilometres northwest of Sydney. Dubbo is situated at the junction of the Newell and Mitchell highways. It is one of the largest country transport centres. Dubbo has an urban population of 25,796, but more than 32,000 people live within city council's boundaries. Dubbo serves a further 100,000 people living in the surrounding region. The Western Plains Zoo was opened in Dubbo in 1977 and has become a major tourist attraction for the city.

Dubbo is the centre of a rich, mixed farming district that specializes in wheat, barley, oats, and lucerne. Farmers also rear sheep and beef and dairy cattle.

Dubbo was proclaimed a village in 1849, a municipality in 1872, and a city in 1966. *Dubbo* is an Aboriginal word meaning *red earth* or *head covering*.

**Dubček, Alexander.** See **Czechoslovakia**.



**José Duarte**



**Madame du Barry**





**O'Connell Bridge**, across the River Liffey, was designed by James Gandon in 1791. Architects rebuilt the bridge in its present form in 1880.

## Dublin

**Dublin** is the capital city of the Republic of Ireland. Its Irish name is *Baile Átha Cliath*. The city lies on Ireland's east coast, in the county of Dublin, in the province of Leinster.

The city lies in a shallow basin at the mouth of the River Liffey. Dublin Bay is a fine natural harbour, sheltered on the north side by the Hill of Howth and on the south side by the Wicklow Mountains. Two other rivers, the Dodder and the Tolka, also flow into the bay. Dublin covers an area of 119 square kilometres. The area including Dublin city, the borough of Dun Laoghaire, and the rest of County Dublin, has a population of more than a million. This is nearly one third of the total population of the Republic.

### People and government

Dublin is the capital of Ireland and the seat of government. The *Oireachtas*, consisting of *Dáil Éireann* (the Lower House) and *Seanad Éireann* (the Senate or Upper House), meets in Leinster House. See **Oireachtas**.

The various government departments are in buildings close to the *Dáil*, while the Department of Foreign Affairs is in St. Stephen's Green. The president lives in *Aras an Uachtaráin*, the former residence of the lord lieutenant, situated in Phoenix Park.

The Corporation of Dublin has elected a mayor since 1229 and a lord mayor since 1665. It administers local government affairs, such as housing, roads, and lighting. The official residence of the lord mayor is the Mansion House in Dawson Street, which dates from the 1700's.

**Religion.** About 92 per cent of the people of Dublin are Roman Catholics and nearly 3 per cent belong to the Church of Ireland. The remainder are Jews, or follow such faiths as Methodism or Presbyterianism.

### Economy

Dublin is primarily an administrative centre, with a strong educational and cultural life. But it has a large business community that is active in banking and insurance. It is also the centre of the country's medical and legal professions.

Traditionally, there has been little industry in the centre of the city, although brewing and distilling have been of importance since the 1700's. The Guinness Brewery, founded in 1759, is now the largest brewery in Europe. Communications, distributive trades, and service industries are the biggest employers. But light engineering and the manufacture of clothes, processed foods, and cars are also important.

### Transport and communication

The country's road system is centred on Dublin. However, some approach roads to the city are poor.

Sean Heuston Station is the terminus of the Cork and Limerick lines and the head office of *Iarnród Éireann*, the national transport company. Connolly Station serves the Belfast, Sligo, and Wexford lines. A rapid-transit railway links central Dublin with Howth to the north and Dun Laoghaire and Bray to the south.

Dublin airport, 10 kilometres north of the city, is the largest airport in Ireland and the main air link between Ireland and the rest of Europe. More than 2 million passengers use it each year.



# Dublin *Ireland's charming cultural and communications centre.*

Capital city and seat of national government of Republic of Ireland.

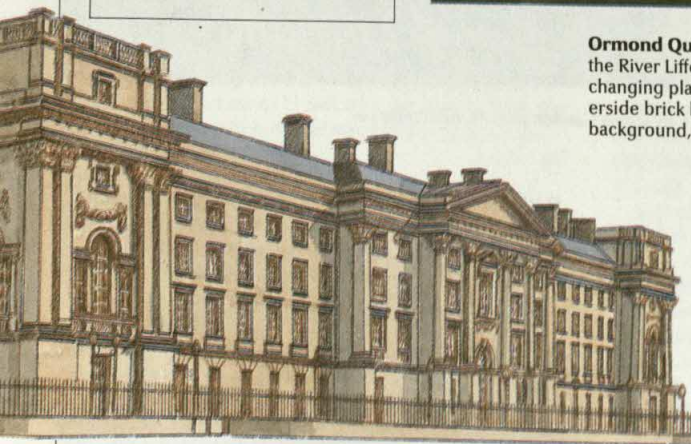
The country's largest city (pop. 478,389; metropolitan area 866,241), it stands astride the River Liffey on the east coast of Ireland. Provides an important link with Europe through its airport north of the city.

Leaders in business, professions, politics, education and arts have long been drawn to Dublin. A city landscape unburdened with high-rise clutter, the youthful energy of its citizens and student population contribute to its urban vitality.



**Ormond Quay**, above, on the River Liffey, displays changing play of light on riverside brick buildings. In the background, right, is the

dome of the Four Courts, completed in 1802 and still serving as a court and legal centre.



**Trinity College**, above, founded in 1592 by Queen Elizabeth I, has about 7,000 students. The College library houses the world-famous *Book of Kells* and many other priceless manuscripts.

**Merrion Square** is known for its handsome Georgian buildings, featuring decorative front doors with their distinctive fanlights, right. Residents included William Butler Yeats and Daniel O'Connell.



**1014** Irish king Brian Boru defeated Viking king of Dublin in Battle of Clontarf.

**1170-1172** Anglo-Norman forces occupied Dublin. Henry II of England established headquarters there.

**1541** Henry VIII declared king

of Ireland at a parliament assembled in Dublin.

**1649** Oliver Cromwell, at head of victorious English army, landed at Dublin on August 15.

**1700's** Dublin enjoyed period of peace, stability, and

growth. Buildings and squares of Georgian elegance developed.

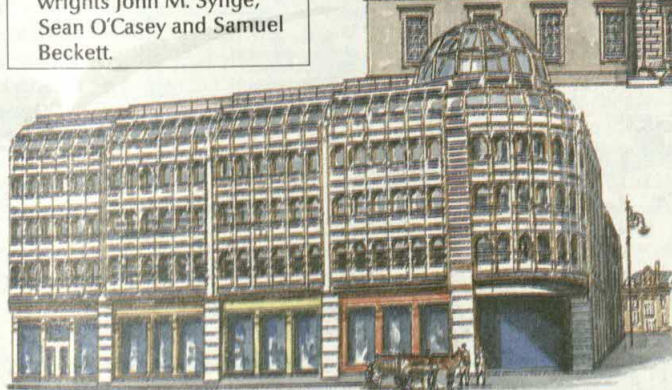
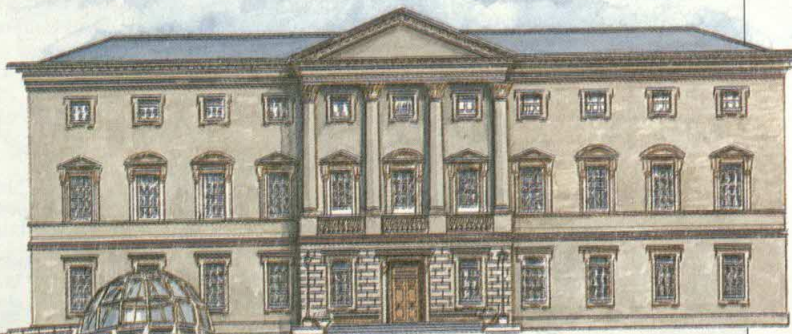
**1800** Dublin had become second city in British Empire (pop. 200,000). But Act of Union abolished Irish Parliament and city fell into decline.



Christchurch Cathedral was built by Vikings. St. Patrick's Cathedral and Dublin Castle were initially built by Normans. Roman Catholic Pro-Cathedral dates from the early 1800's.

Noted for its citizens' love of eloquent language and the arts, and rich in literary associations. Born in or near Dublin were poet William Butler Yeats, writers James Joyce and Brendan Behan, and playwrights John M. Synge, Sean O'Casey and Samuel Beckett.

**Leinster House**, below, on Merrion Square, was built for the Duke of Leinster in 1745. It is now seat of the Irish Parliament. The Parliament comprises the Senate, or Upper House, and the *Dáil Éireann*, which makes the laws of the Republic.



**St. Stephens Green**, an elegant square with gardens laid out in 1880, features a glass-roofed shopping centre, above. Archaeological finds in the area indicate that human habitation there dates from prehistoric times.



**Ha'penny Bridge**, right, so-called after a toll once charged, is a footbridge over the Liffey. Between the Four Courts and the Custom House buildings, it affords fine views of the city.



**The Parnell Monument**, above, honouring Charles Stewart Parnell (1846-1891), Irish nationalist leader, stands in O'Connell Street. Dublin contains many other fine public monuments and sculptures.

**1829** Emancipation Act, allowing Roman Catholics to sit in Parliament, passed in recognition of political leadership of Daniel O'Connell. He was later elected lord mayor of Dublin.

**1858** Revolutionary Republican Brotherhood formed.

**1893** Gaelic League founded.

**1904** Abbey Theatre founded.

**1916** Easter Rising: Irish Republic proclaimed at Dublin's General Post Office. Rebellion was crushed in a week by British forces.

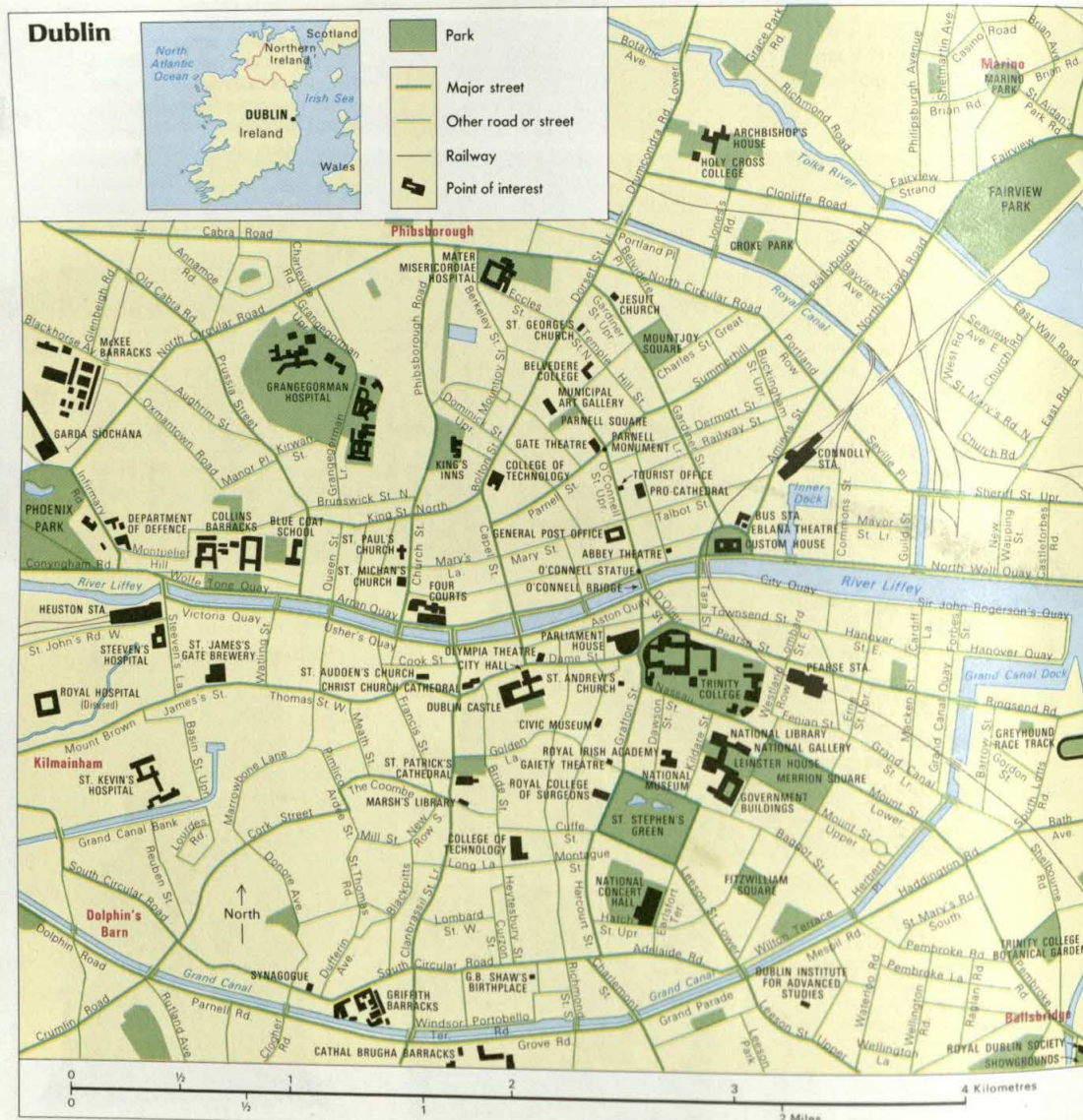
**1919-1922** War of Independence, 1919-21, and Civil War,

1922, damaged many sections of the city.

**1988** Dublin celebrated a thousand years of history; new parks and sculptures and improvements for pedestrians enhanced city.

**1991** Dublin designated year's European City of Culture.





Dublin is the largest port in the Republic of Ireland, handling nearly 7 million metric tons of freight each year. There are also car ferry services operating between Dublin and the cities of Holyhead and Liverpool.

The national radio and television service, Radio Telefís Éireann, operates from Dublin. Three national newspapers are printed in Dublin: *The Irish Times*, *The Irish Independent*, and *The Irish Press*.

### Education and culture

**Universities.** Trinity College was founded in 1592 by Queen Elizabeth I on the site of the Monastery of All Hallows. Trinity has a copyright library (see **Library**). It also has an important collection of Celtic manuscripts, including the *Book of Kells*. The college, which is in the city centre, has more than 10,000 students. University College Dublin (UCD), part of the National University of

Ireland, is centred on Belfield in the southeastern suburbs of the city. Dublin City University, in the northern suburbs, was founded in 1989. It originated as a national institute of education.

**Museums, libraries, and art galleries.** The National Museum, in Kildare Street, houses an important collection of Celtic antiquities, including gold ornaments and early Christian art. The Civic Museum, in South William Street, has a collection relating to Dublin's history. The National Gallery is in Merrion Square, the finest of the city's Georgian squares. It has a wide collection of European and Irish painting. The Municipal Gallery, in Parnell Square, has the Hugh Lane collection of modern art. It also has some important Impressionist paintings. The Royal Hibernian Academy and the Oireachtas hold annual painting shows.

Marsh's Library, beside St. Patrick's Cathedral, was



founded by Archbishop Narcissus Marsh in 1702. It is the oldest public library in Ireland.

**Entertainment.** Dublin is famous for its theatres. The Abbey Theatre performs plays by Irish playwrights (see **Abbey Theatre**). The Gate Theatre, formerly directed by Micheál MacLiammóir and Hilton Edwards, has a more international repertoire. Other theatres are the Gaiety and the Olympia. A theatre festival is held in Dublin each October. Musical life focuses on two music colleges, the Trinity College Music School, and Radio Telefís Éireann Symphony Orchestra. A new concert hall opened in 1981. In 1991, Dublin was the year's European City of Culture.

### Sightseeing in Dublin

Much of the city has impressive public buildings surviving from the 1700's. These lie within the arms of the Grand and Royal Canals. The city is largely built of red brick, although the more important buildings are of granite or limestone. O'Connell Street, the main thoroughfare, is an exceptionally wide street. The main shopping streets are Henry Street, off O'Connell Street, and Grafton Street, on the south side of the Liffey. The Bank of Ireland, formerly the Parliament House, was built in 1729 by Sir Edward Lovett Pearce.

**Buildings.** Two classical buildings lie on the Liffey. They are the Custom House, built in 1781, and the Four Courts (law courts), built in 1786. Other important buildings include Dublin Castle, for a long time the centre of British rule; Christchurch Cathedral, founded in 1038, the Church of Ireland cathedral for the archdiocese of Dublin; St. Patrick's, the National Cathedral of the Church of Ireland; and the Catholic Pro-Cathedral, a handsome neo-Greek building dating from 1816.

**Recreation areas.** To the northwest of the city lies Phoenix Park, which covers 709 hectares, making it the largest city park in Europe. It contains Dublin Zoo, famous for its lions, and the Wellington Testimonial.

Also in the north are Croke Park, the Gaelic Athletic Association stadium, and the Dalymount Park association football ground. Rugby union internationals are played at Lansdowne Road, in the south of Dublin. The Dublin Horse Show is held at the Royal Dublin Society's showgrounds at Ballsbridge each August. Race courses are at Leopardstown and Phoenix Park.

### History

The Irish name for Dublin (*Baile Átha Cliath*) comes from a crossing of the Liffey called the Ford of the Hurdles. The English name derives from the Danish *Duibhlinn* (Dark Pool), the Danish harbour on the Liffey. The Danes founded the first settlement on a hill on the south bank of the Liffey in 841. The settlement prospered to become a Danish kingdom.

Dublin was captured by the Anglo-Normans in 1170. In 1172, Henry II made it the centre of English administration in Ireland. Initially, the Anglo-Norman conquest of Ireland was successful, but owing to a lack of settlers, the colony shrank to a coastal strip around Dublin. This area, which was called the *Pale*, remained under English rule throughout the medieval period. Dublin remained a small walled city until the expansion of the English colony in the 1500's, when it asserted its position as the chief east-coast trading port and link with England.

During the campaign of Oliver Cromwell, in the 1650's, the city of Dublin surrendered, avoiding a massacre. During the 1700's, peace and stability reigned at Dublin. With increased trade, better communications with England, and an independent parliament (Grattan's Parliament) from 1782 to 1800, Dublin grew to be the second city in the British Empire. By 1800, Dublin's population stood at 200,000.

After the Act of Union of 1800, the Irish Parliament at Dublin was abolished. As a result, Dublin became a provincial city. The major part of the Georgian city survived during the 1800's and the first part of the 1900's. But the 1916 rising, led by P. H. Pearse from the General Post Office, the War of Independence of 1919-1921, and the Civil War of 1922 all contributed to the destruction of a large part of the north city centre. Since the emergence of the Republic of Ireland as an independent state, Dublin's wealth has increased and its population doubled.

See also **Ireland, History of.**

**Dublin** is a county in the province of Leinster on the east coast of Ireland. It is the third smallest county in the Republic of Ireland, but almost 30 per cent of the republic's people live there. This is because the county contains the city of Dublin, the capital and by far the largest city in the Republic of Ireland. For more information on the city of Dublin see **Dublin (city)**. County Dublin also contains the important seaport of Dun Laoghaire.

### People and government

The administrative area of the city of Dublin forms a county borough within County Dublin with separate local government. A lord mayor and corporation are in charge of local government in the county borough. The population of the county borough increased from about 290,000 in 1901 to a peak of about 570,000 in 1971. During the 1980's the population declined, partly as a result of people moving from the city centre to the suburbs.

The metropolitan area of the city of Dublin extends far beyond the boundaries of the county borough. From the mid-1980's onward, the number of people living in the



The pleasant seaside resort of Howth is a popular tourist attraction in County Dublin. The island called Ireland's Eye is in the Irish Sea just north of Howth.



county outside the borough boundaries exceeded that residing within the borough. Most spectacular was the growth of Tallaght to the southwest. Tallaght grew from a small village in 1960 to a town of 60,000 by 1980.

For many years, an elected county council and the borough corporation of Dun Laoghaire administered the region of County Dublin lying outside the county borough. In 1985, plans were announced for three new county authorities in place of the old county council and Dun Laoghaire council. The new administrative areas are Dun Laoghaire-Rathdown (pop. 185,362) to the south-east, Dublin-Belgard (pop. 208,666) to the southwest, and Dublin-Fingal (pop. 152,726) to the north.

County Dublin elects 48 members of *Dáil Éireann* (lower chamber of the parliament of the Republic of Ireland). Both houses of the national parliament meet in Leinster House in the city of Dublin. Most of the offices of the various government departments are in nearby parts of the city. The residence of the president of Ireland is *Aras an Uachtaráin*, in Phoenix Park. The Four Courts building on the River Liffey houses the Supreme, High, and Criminal Courts of Ireland. The headquarters of the national police force, the Garda Síochána, is at Phoenix Park. Mountjoy is the main prison. The Irish Air Corps is at Baldonnel in southwest County Dublin.

About 91 per cent of the county's population is Roman Catholic. The Church of Ireland is the next largest denomination, and there are some Presbyterians and Methodists. Almost all of Ireland's small Jewish community lives in Dublin.

For both the Roman Catholic Church and Church of Ireland, there is an archdiocese of Dublin, led by an archbishop. There are two Church of Ireland cathedrals, St. Patrick's Cathedral and Christchurch Cathedral, both in the city of Dublin. The main Roman Catholic church is the Pro-Cathedral, which is also in the city of Dublin.

The headquarters of most of the sporting organizations in the Republic of Ireland are in the city or county of Dublin. There are major Gaelic football and hurling matches at Croke Park. International rugby and soccer matches take place at Lansdowne Road. County Dublin has many golf clubs. The most famous of these is at Portmarnock. Horse riding is popular, and horseracing meetings are held at Leopardstown racecourse. The annual Dublin Horse Show takes place in Ballsbridge.

Many people take part in sailing and other activities along the coast. City parks, such as St. Stephen's Green, are important recreation areas. Phoenix Park (with an area of 709 hectares) is one of the largest and finest urban parks in the world. It contains Dublin Zoo.



**Dublin**, on the eastern coast of Ireland, is bordered by the Irish Sea. It is the gateway to the central lowlands of Ireland.

Famous writers associated with the city and county of Dublin include Samuel Beckett, Brendan Behan, James Joyce, Sean O'Casey, George Bernard Shaw, Richard Brinsley Sheridan, Jonathan Swift, John Millington Synge, Oscar Wilde, and William Butler Yeats.

### **Economy**

More than half of County Dublin is agricultural land but fewer than 1 person in 100 living in the county works in farming. Two-fifths of the farmland is used for arable crops. This is more than in any other Irish county. Barley, potatoes, vegetables, and wheat are the main crops. The north Dublin coast is Ireland's major market gardening area for vegetables and fruit. Grassland areas are used for cattle production, and there is some dairying. Horses are kept near the city of Dublin for riding and for breeding. Many farmers raise pigs and poultry.

One-fifth of County Dublin's people work in manufacturing industries. Light engineering is the largest and fastest-growing sector. Many factories make electrical and electronic equipment. The local food and drink industry includes the internationally famous Guinness brewery, founded in 1759. Another important group of industries comprises printing, publishing, and the manufacture of paper products. The textile and clothing industries have declined but are still significant. Other manufactures include chemicals, furniture and glass.

Dublin has nearly 30 per cent of the manufacturing workforce in the Republic of Ireland, but this share is declining. This is because new industries have grown throughout the country, while some Dublin industries have closed, causing high unemployment.

Dublin's economy depends increasingly on service industries, which account for almost three-fourths of employment. Education, health, and other professional services form the largest group. Many people are employed in retail and wholesale distribution. Other important service industries include finance and banking, personal services, public administration, tourism, and transportation. There is a new centre for financial services at the Custom House Dock. Many businesses and other organizations have their headquarters in Dublin.

### **Facts in brief about County Dublin**

**Population:** 1991 census—1,024,429.

**Area:** 922 km<sup>2</sup>.

**Largest towns:** Dublin, Dun Laoghaire, Tallaght, Clondalkin, Swords, Lucan, Malahide, Portmarnock, Balbriggan, Skerries.

**Chief products:** *Agriculture*—barley, cattle, fruit, horses, milk, pigs, potatoes, poultry, vegetables, wheat. *Other primary products*—building stone, fish, sand and gravel.

*Manufacturing*—beer, chemicals, clothing, electrical and electronic goods, food products, furniture, glass, machinery and instruments, printing and paper products, textiles.

**Origin of name:** From the Irish *Dubh linn* (black pool). The name in Irish is *Baile Átha Cliath* (the ford of the hurdles).





**Yachts in Dun Laoghaire harbour** prepare for an evening sailing race. Sailing is a popular pastime in County Dublin.

The building and construction industry is an important branch of Dublin's economy. There is a large electricity power station in Dublin port, which mainly uses natural gas from Cork. Howth is one of Ireland's leading fishing ports. Fishing is also important at the towns of Skerries, Balbriggan, and Dun Laoghaire.

Dublin city is the focus of transport and communications in Ireland. Major roads and railways radiate from it to the main cities in the country. A rapid transit railway (DART) serves the area around Dublin Bay from Howth to Bray. Traffic congestion is a problem on the streets of the city. The Grand Canal and the Royal Canal link Dublin to the River Shannon, but they have not been used commercially since the 1950's.

Dublin airport, to the north of the city, has services to many cities in the United Kingdom (UK) and mainland Europe, and also to North America. Dublin is the major commercial port in the Republic of Ireland. It handles two-fifths of the Republic's foreign trade. There are ferry services from Dublin and Dun Laoghaire to Holyhead in Wales.

The headquarters of the national radio and television authority, Radio Telefís Éireann (RTE) are at Donnybrook.

### Land

The Irish Sea forms County Dublin's eastern boundary. Inland, the county borders on County Meath to the north and northwest, County Kildare to the west, and County Wicklow to the south. County Dublin measures less than 50 kilometres from north to south and half that distance from east to west. Dublin lies on the east coast of Ireland and has ferry and air links to the United Kingdom and other European countries. But it is also the gateway to the central lowlands of Ireland. This has been a major factor in its development.

Dublin city lies on the River Liffey where it enters the Irish Sea in the broad expanse of Dublin Bay. The rivers Dodder and Tolka also flow into the bay. Headlands at

Howth to the north and Killiney to the south form the boundaries of the bay, but the remainder of the Dublin coast is low-lying.

The uplands rise from the southern edge of the city of Dublin. This area of mountains and forests continues into County Wicklow and at its highest reaches over 500 metres. Dubliners thus have an area for recreation very close to the busy capital. The uplands of County Dublin are made of granite, slate, and shale. The remainder of the county is lowland, mainly limestone.

County Dublin is the driest part of Ireland, with an annual rainfall of 75 centimetres. The average temperatures are 5° C in January and 16° C in July.

### Chief towns

Chief among the towns outside the city of Dublin are Dun Laoghaire, Tallaght, Swords, Balbriggan, and Clondalkin. Dun Laoghaire is by far the largest and most important. It is the fourth largest town in the Republic of Ireland and lies southeast of Dublin city. With Dublin it forms a continuous urban area, and many of its inhabitants travel each day to work in Dublin's city centre. Dun Laoghaire is a seaport, seaside resort, and ferry terminal. It is also a centre for boating and yachting and has bathing places at Sandycove, Blackrock, and other spots on the coast. The great Scottish civil engineer Sir John Rennie (1761-1821) designed the fine harbour in Dun Laoghaire. Blackrock is famous for its boys' school, Blackrock College, where the Irish politician Eamonn de Valera was both a pupil and a teacher.

The name Dun Laoghaire means "Leary's Fort" and refers to Laoghaire (Leary), a king of the A.D. 400's. From 1821 to 1920, Dun Laoghaire was called Kingstown.

The village of Swords, now a suburb of Dublin city, once had a famous monastery in pre-Norman times. The round tower, all that remains of this monastery, is popular with tourists. Some of Dublin city's workers travel daily from their homes in Swords.

Balbriggan, in the north of the county, is a coastal resort with fine beaches. It is also a small manufacturing town, once famous for its hosiery. The local river, the Delvin, is a popular place with anglers seeking brown trout.

Clondalkin, southwest of the city of Dublin, is another former monastic site. It is now an industrial area manufacturing paper and tiles.

For details of Dublin history see **Dublin** (city).

**Dublin, University of**, more generally known as Trinity College, Dublin, was founded in 1592 under a charter granted by Queen Elizabeth I. The financial support of this university came from funds and property given by James I. The university has faculties of arts, science, economic and social studies, engineering and systems sciences, and health sciences. It has more than 10,000 undergraduate and postgraduate students.

**Dubois, Eugène** (1858-1941), was a Dutch anatomist and physical anthropologist. While in Java in 1891 and 1892, he discovered the fossilized bones which he later named *Pithecanthropus erectus*, or *the apeman that walked erect* (see *Java man*). His discovery led to the theory of a single "missing link" in the chain of evolution joining apes and human beings. Later discoveries have led scientists to believe that *Pithecanthropus* is only one form among many in the human evolutionary process.



**Du Bois, W. E. B.** (1868-1963), was one of the most important leaders of black protest in the United States. During the first half of the 1900's, he became the leading black opponent of racial discrimination. He also won fame as a historian and sociologist.

Du Bois was probably the first black American to express the idea of *Pan-Africanism*. Pan-Africanism is the belief that all people of African descent have common interests and should work together to conquer prejudice. In 1900, Du Bois predicted that humanity's chief problem of the new century would be "the colour line."

William Edward Burghardt Du Bois was born in Great Barrington, Massachusetts. He graduated from Fisk University in 1888. In 1895, he became the first black to receive a Ph.D. degree at Harvard University.

From 1897 to 1910, Du Bois taught history and economics at Atlanta University. He attended the First Pan-African Conference in London in 1900. He later organized Pan-African conferences in Europe and the United States. Du Bois received the Spingarn Medal in 1920.

Du Bois opposed the idea that blacks could advance themselves by hard work and said that they should speak out against discrimination, with college-educated blacks leading the fight against prejudice. Many of his ideas appear in *The Souls of Black Folks* (1903). He also wrote *Black Reconstruction in America* (1935). Du Bois founded the Niagara Movement in 1905 and helped set up the National Association for the Advancement of Colored People (NAACP). From 1910 to 1934 he edited the NAACP magazine *Crisis*. In 1934 Du Bois left the NAACP and went back to Atlanta to teach. He again worked for the NAACP from 1944 to 1948. In 1961, Du Bois, frustrated by the slow progress of black advancement in America, joined the Communist Party and moved to Ghana.

**Duboisias** are small Australian trees that contain poisonous sap. Aborigines are reported to have used the sap as a narcotic and also to drug emus and fish. Two species of duboisias grow only in Australia, and a third is also found in New Caledonia.

**Scientific classification.** Duboisias belong to the potato and tomato family, Solanaceae. They are genus *Duboisia*.

**Dubos, René Jules** (1901-1982), a French-American microbiologist, pioneered in the development of antibiotics, a type of drug. In 1939, Dubos developed tyrothricin, the first commercially produced antibiotic, from a substance made by soil bacteria. His work led other researchers to develop the antibiotics penicillin and streptomycin.

Dubos also investigated and wrote about human relationships to both the natural and social environment. He shared the 1969 Pulitzer Prize for general nonfiction for *So Human an Animal* (1968).

Dubos was born in Saint-Brice, near Paris, France. In 1927, he earned a Ph.D. degree from Rutgers University and joined the Rockefeller Institute for Medical Re-



W. E. B. Du Bois

search (now Rockefeller University). He became a United States citizen in 1938.

**Dubuffet, Jean** (1901-1985), was a French artist known for the primitive style of his works. Dubuffet's style draws its chief inspiration from crude wall drawings called *graffiti* and the art produced by children, insane people, and primitive cultures. His painting *Business Prospers*, which appears in the **Painting** article, is typical of his style.

Dubuffet was extremely interested in the materials used in painting. In many of his pictures, he used unusual combinations of substances such as sand, gravel, cement, glue, and tar to achieve especially rough textures. For example, he used plant leaves to create *The Gardener*, a collage. He produced other works by cutting up painted canvases and reassembling the pieces. Dubuffet often used simple or crude images to shock people who were used to beautiful pictures.

Dubuffet was born in Le Havre. He studied art as a young man but worked as a winemaker until he seriously devoted himself to painting in 1942. He influenced younger artists in the late 1940's and helped bring the return of recognizable subject matter to painting at a time when abstract art was popular.

**Ducat** is a coin first issued by Roger II of Sicily, Duke of Apulia, in the mid-1100's. It was called a ducat because it was issued by authority of a duchy. Later the coin was used in all southern European countries, either in silver or in gold.

**Duccio di Buoninsegna** (1250?-1319?) was the first great painter from Siena, Italy. He became noted for the graceful faces and the soft drapery of his figures. His painting grew out of the earlier Gothic and Byzantine styles, while anticipating the more humanistic art of the Renaissance. From 1308 to 1311, he painted *The Maestà*, the great altarpiece of the cathedral in Siena. It shows the Madonna enthroned, surrounded by angels and saints. Duccio also created miniature paintings for books. He was born in Siena. See also **Jesus Christ** (picture: Jesus restored a blind beggar's sight).

**Duchamp, Marcel** (1887-1968), was a French-born American artist and a leader of the modern movement in art. Duchamp created works that challenged the traditional definition of art. His unconventional approach helped to develop an atmosphere of creative freedom for other artists and has continued to be influential.

Duchamp's best-known painting is *Nude Descending a Staircase, No. 2* (1912). The depiction of the human figure as a sequence of planes shows the influence of a style called *cubism* that was developed about 1910 in France. This painting first shocked Duchamp's older artistic colleagues in France in 1912. It caused an even greater sensation in 1913 when it was displayed at the New York Armory Show, the first large exhibition of modern art in the United States. The painting baffled and outraged many viewers, to whom it symbolized the unintelligibility of modern art.

Many of Duchamp's works were simply everyday objects that he gave titles and exhibited as art. He called these works *ready-mades*. Duchamp's most controversial ready-made was a common urinal that he titled *Fountain* and signed with the name "R. Mutt." By wittily designating ordinary objects as works of art, he hoped to make people examine their own standards of art.





Oil painting on canvas (1912); Philadelphia Museum of Art, Philadelphia, U.S.A.

**Nude Descending a Staircase, No. 2**, is Marcel Duchamp's most famous painting. It caused a sensation at the Armory Show of modern art in New York City in 1913. The painting shows motion by blending a series of movements into one picture.

The most important and complex work of Duchamp's career is the unfinished *The Bride Stripped Bare by Her Bachelors, Even*, sometimes known as the *Large Glass*. In this work of oil paint, wire, and lead foil enclosed in glass, Duchamp explored such themes as sexuality and the increasing mechanization of human life.

Duchamp was born in Blainville, France, near Rouen. In 1904, he went to Paris, where he met artists who later led modern art movements. Duchamp shared many ideas with artists known as *dadaists* and *surrealists*, but he was not identified exclusively with any group. He settled in the United States in 1942.

See also **Dadaism; Painting** (Dadaism; picture: *Chocolate Grinder, No. 1*); **Surrealism**.

**Du Châtelet, Marquise**. See Voltaire (Exile).

**Duchess**. See Duke.

**Duchy of Cornwall**. See Cornwall.

**Duchy of Lancaster**. See Lancaster, Duchy of.

**Duck** is a bird with waterproof feathers and webbed feet. Ducks are related to both geese and swans. But ducks have shorter necks and wings and flatter bills, and they quack or whistle rather than honk. Male

ducks are called *drakes*, and females are called *ducks*.

Ducks live throughout the world in wetlands, including marshes and areas near rivers, ponds, lakes, and oceans. They live in arctic, temperate, and tropical regions for some or all of the year. Many kinds of ducks migrate long distances annually between their breeding grounds, where they rest and raise their young, and their wintering areas, where the water does not freeze. Some ducks migrate thousands of kilometres in large flocks every year.

Most ducks are good to eat. Farmers raise the ducks that people buy to eat at home and in restaurants. Duck farming is a profitable business in parts of Europe, Australasia, and the United States.

### The features of a duck

Ducks spend a lot of time in water, where their webbed feet serve as paddles for swimming and diving. They are graceful on water, but waddle clumsily when walking on land because their legs are set on the sides and toward the rear of the body. Most common wild ducks weigh from 1 to 2 kilograms, but some of the smaller species weigh less than 0.45 kilogram.

The various kinds of ducks get their food in different ways, depending on their body features. Some ducks extend their long necks down through shallow water. Others dive for food in deep water. Ducks that sift food have wide bills with edges that strain seeds, insects, and snails from the water. Some ducks have short bills that they use to pry barnacles from rocks or to grab clams. Others have long, narrow bills with sawlike edges for catching and holding fish.

Ducks protect themselves from cold water by waterproofing their feathers. They use their bills to rub the feathers with a waxy oil from a gland at the base of the tail. Under the oiled feathers is a layer of soft, fluffy feathers called *down*. Down helps insulate a duck's body because it traps air under the outside feathers. Eider-down—the down from female eider ducks—is famous as a stuffing for bed covers.

Most drakes have bright-coloured feathers. Their colours include green, blue, red, and chestnut. But drakes of some species are mostly black and white. Most females are brown and can hide by blending with the surroundings when incubating eggs or caring for young.

### The life of a duck

Ducks seek mates during winter. The bright colours of the drakes attract females. A female usually leads her drake to the breeding grounds during the spring migration, often returning to the same wetland where she was hatched. The ability of ducks and other birds to return to the same places each year is called *homing behaviour*. Once on the breeding grounds, each male defends a small territory from which he drives away other males or other pairs of his own species. The female builds a nest in a clump of grass or reeds, or in a hole in a tree. The shelduck often nests in rabbit burrows.

**Ducklings**. The female duck lays from 5 to 12 eggs. After she starts to sit on the eggs to warm and protect them, the drake leaves to join other males. The ducklings hatch from three weeks to a month later.

Female redhead ducks of North America sometimes lay eggs in the nests of other species. They often de-





**A wood duck and her ducklings** stay close together so she can protect them from enemies. Most ducklings can swim on the day they are born, but they cannot fly for several weeks.

pend on the other ducks to hatch the eggs and care for the young. Most ducklings look alike, and the new mother accepts them.

Ducklings can run, swim, and find food for themselves within 36 hours of hatching. A group of ducklings is called a *brood*. A mother duck keeps her brood together so she can protect it from predators. Animals that prey on ducklings include birds of prey, herons, large fish, and turtles. Sometimes the ducklings in one brood mix with another. As a result, some females end up with broods of 15 to 25 ducklings, while others have only 2 or 3. Ducklings grow quickly and have most of their feathers in about a month. They learn to fly in five to eight weeks.

**Food.** Ducks that do not dive for food are called *dabbling ducks*. They eat mostly wetland plants, including the seeds of aquatic weeds, grasses, sedges, and rushes. They also eat insects and other small animals that they find on or under the water. *Freshwater diving ducks* take roots, seeds, snails, insects, and small clams from the bottom of ponds and lakes. In salt water, dabbling ducks feed on snails, barnacles, shrimp, and mussels, as well as on plants. *Wood ducks* eat acorns, small fruits, insects, and seeds.

*Mergansers*, a kind of sea duck, eat mostly fish, which they catch in either salt water or fresh water. *Eiders* and other sea ducks pull crabs, barnacles, and shrimp off rocks and weeds. They dig snails, cockles, mussels, and clams from the bottom, and also catch fish.

**Habits.** Once the female duck has nested, the drake usually leaves her and joins other drakes to *moult* (lose its old feathers). During this moult only, the drake also loses his flight feathers and cannot fly. He moults again in early autumn and regains his bright male colouring.

### Facts in brief about ducks

**Names:** Male, drake; female, duck; young, duckling; group, flock.

**Incubation period:** 23 to 30 days, depending on species.

**Number of eggs:** 5 to 12, depending on species.

**Length of life:** 2 to 12 years (shoveler and mallard reported to 20 years).

**Where found:** All parts of the world except Antarctica.

After her ducklings hatch, the female also moults, and replaces all her feathers.

After growing new feathers and after the young learn to fly, the ducks gather in flocks on large lakes, marshes, or shallow places in the ocean to migrate to their wintering grounds. They usually fly in long lines or "V" formations. Flocks use the same summer and winter areas year after year, even stopping to rest at the same spots along the way. Some ducks fly only a short distance. Others make long flights from their breeding grounds within the Arctic Circle to overwinter several hundred kilometres to the south.

### Kinds of ducks

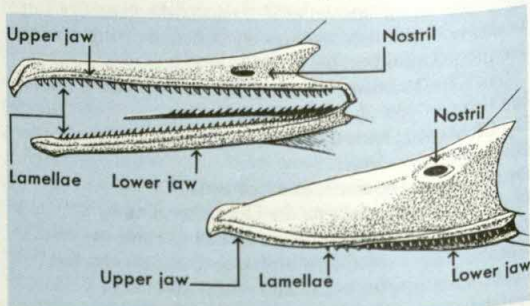
Scientists classify ducks into eight *tribes* (groups). The scientific name of the tribe appears in parentheses after the common name.

**Dabbling ducks** (Anatini) include mallards, wigeons, pintails, baldpates, gadwalls, green-winged teals, blue-winged teals, cinnamon teals, and shovellers. These birds tip bottom-up in shallow water, stretching their necks to feed on the bottom. They take off from water in quick jumps. All dabbling ducks except gadwalls have shiny coloured patches on their wings. Gadwalls have white wing patches.

Nearly all domestic ducks are dabbling ducks that developed from wild mallards. The most common com-

### Two types of duck bills

Diving ducks have long, narrow bills, *top*, with toothlike edges to hold fish. Dabbling ducks have short, broad bills for prying.





mercially raised ducks include the White Pekin, Aylesbury, muscovy, Indian Runner, and Khaki Campbell.

**Freshwater diving ducks** (Aythyini) include pochards and scaups. Among the pochards are the canvasbacks, tufted duck, and ferruginous duck. They swim underwater with their wings closed and their legs sticking out to the sides. They have short wings and their legs are closer to the rear of the body than those of most other ducks. Freshwater diving ducks run along the surface of the water to get airborne.

**Perching ducks** (Cairinini) include wood ducks, mandarin ducks, and muscovy ducks. They are extremely colourful ducks of eastern North America and the tropical regions of Africa, Asia, and Central and South America. They often perch in trees.

**Sea ducks** (Mergini) include mergansers, eiders, scoters, long-tailed ducks, harlequins, buffleheads, and

goldeneyes. Mergansers have long, narrow bills with sawlike edges to hold fish. Long-tailed ducks dive deeper—up to 55 metres—than any other water bird. Eiders produce down that is valuable as insulation in bedding and winter clothing. The Labrador duck, the only extinct duck of North America, was a sea duck.

**Shelducks** (Tadornini) are bulky, short-billed ducks with an upright stance. Both sexes have similar plumage and the young are covered with black and white down. They live in Europe, Africa and Asia.

**Steamer ducks** (Tachyerini) are heavily built, short-winged sea ducks. They live in southern South America.

**Stiff-tailed ducks** (Oxyurini) are small, rounded ducks with long, spiky tail feathers. The tail feathers are used to steer the duck underwater in search of food. Most stiff-tailed ducks live in freshwater regions of the Southern Hemisphere. A common type is the North

## Types of ducks

Scientists classify ducks into eight separate groups called *tribes*. Members of six of the tribes are illustrated below. They are the dabbling duck, freshwater diving duck, perching duck, sea duck, shelduck, and stiff-tailed duck. The other two tribes are the steamer duck and the torrent duck.



**Dabbling ducks** (Anatini)

### Mallard

*Anas platyrhynchos*  
Found in Northern Hemisphere  
(70 centimetres)



**Freshwater diving ducks** (Aythyini)

### Greater scaup

*Aythya marila*  
Found in Northern Hemisphere  
(50 centimetres)



**Perching ducks** (Cairinini)

### Mandarin duck

*Aix galericulata*  
Found in eastern Asia and Japan  
(50 centimetres)



**Sea ducks** (Mergini)

### Red-breasted merganser

*Mergus serrator*  
Found in polar region, Northern Hemisphere  
(58 centimetres)



**Shelducks** (Tadornini)

### Common shelduck

*Tadorna tadorna*  
Found in Europe and Asia  
(60 centimetres)



**Stiff-tailed ducks** (Oxyurini)

### Ruddy duck

*Oxyura jamaicensis*  
Found in North and South America and West Indies  
(43 centimetres)



American ruddy duck, named from the male's shiny red-dish plumage. Although ruddy ducks are among the smallest ducks, they lay eggs about twice the size of a chicken's egg.

### Protection of ducks

Most wild ducks are hunted during migration, and on their winter feeding grounds. Today, various conservation agencies protect ducks. Laws regulate the number that hunters may kill. International treaties help protect ducks as they fly over different countries on migration. Refuge areas preserve important wildlife habitats for ducks. Nest boxes are put up on some reserves to help hole-nesting tree ducks, in places where trees with holes are scarce. Refuge managers may also raise and lower water levels in ways that produce good food plants and nesting cover for ducks. However, despite protection of many areas, the drainage of wetlands remains a major threat to ducks.

**Scientific classification.** Ducks are in the class Aves and in the order Anseriformes. They belong to the family Anatidae.

**Related articles** in *World Book* include:

Canvasback	Goose	Pintail	Teal
Eider duck	Mallard	Shoveler	Wigeon
Gadwall	Merganser	Swan	Wood duck

**Duck** is a lightweight canvas usually made of linen, cotton, or synthetic fibres in a plain weave. Duck is woven in many widths and weights. This stout, waterproof fabric is used for the aprons of cooks, waiters, and butchers; for the uniforms of dentists and surgeons; and for shower curtains, pressing cloths, and tennis shoes. The heaviest grades of duck are used to make machine aprons, machinery conveyor belts, boat sails, tarpaulins, tents, and mailbags. See also *Canvas*.

**Duckbill.** See *Platypus*.

**Ducking stool** was a form of punishment usually given to "witches and nagging women" in England and the American Colonies from the 1600's to the early 1800's. The ducking stool was a chair fastened to the end of a long plank extended from the bank of a pond or stream. The victim was tied securely to the chair and *ducked* (plunged) into the water several times.

**Duckweed** is the name of several species of tiny plants that float on pools and ponds. A duckweed has



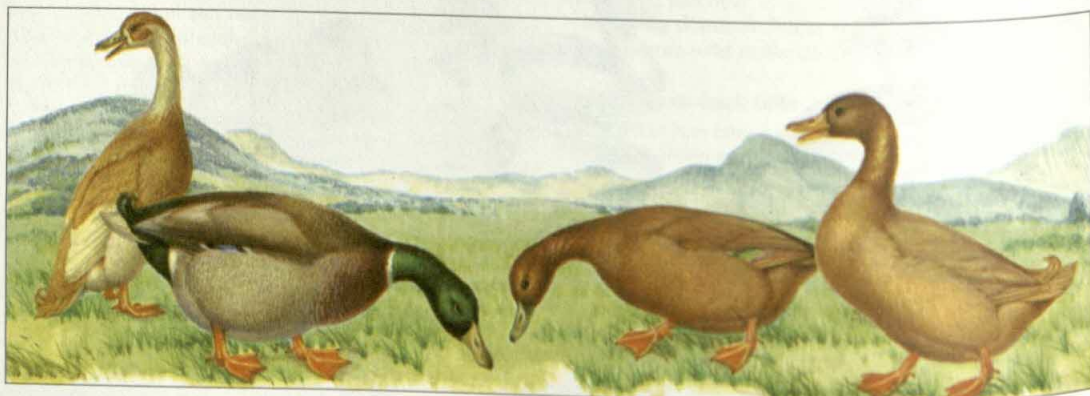
**White Pekins** are among the most common ducks raised commercially. They weigh about 3.5 kilograms.

no ordinary stem or true leaves. It consists of a flat green structure, usually with a single hairlike root underneath. The *common duckweed* is the smallest flowering plant known. It measures only 1.6 to 4.8 millimetres long. Duckweeds are sometimes grown as food for ducks and fish.

**Scientific classification.** Duckweeds belong to the duckweed family, Lemnaceae. The scientific name for the common duckweed is *Lemna minor*.

**Ducommun, Élie.** See Nobel Prizes (table: Nobel Prizes for Peace—1902).

**Ducted propeller** is a propeller that turns within a cylinderlike device called a *duct*. Ducted propellers are used primarily on air-cushion vehicles. Putting a propeller inside a duct makes the propeller more efficient. The duct captures air thrown to the side by the propeller.



**Most kinds of domestic ducks** developed from wild mallards. Common species besides the White Pekin include, *left to right*, the Indian Runner, the Rouen, the Khaki Campbell, and the Buff. Duck farms supply domestic ducks to restaurants, supermarkets, and homes.





**Ducted propellers** power these high-speed amphibious landing craft used by the United States Navy to carry troops and equipment. Putting a propeller in a cylinder-like device called a *duct* makes the propeller more efficient and provides quieter operation than a propeller without a duct.

This action increases the air pressure behind the propeller blades and therefore increases the propeller's driving force.

The increased thrust provided by a ducted propeller permits manufacturers to reduce the size of the propeller. Ducted propellers also operate more quietly than do propellers without ducts.

See also **Hovercraft**.

**Ductility** is the ability of certain solids to undergo permanent changes in shape without breaking. For example, a piece of copper can be drawn to make a thin wire. But the shape of a brick cannot be permanently changed except by breaking it.

Ductility is a valuable property of many metals, including aluminium, gold, iron, nickel, and silver. These metals can be drawn into wire, hammered into various shapes, or rolled into sheets. The term *malleability* is often used in place of ductility to describe the property of metals that allows them to be hammered into thin sheets. Metals are not the only ductile substances and not all metals are ductile. For example, modelling clay is a ductile nonmetallic substance and impure tungsten is a nonductile metal.

**Dude ranch** is an American Western-style ranch which receives paying guests, called *dudes*. These dudes are usually city dwellers who get little physical activity and contact with nature.

Some dude ranches are ordinary cattle or sheep ranches that entertain a few guests as a sideline. But other ranches are devoted entirely to entertaining dudes. Most of the dude ranches are in the "cow country" of Montana, Wyoming, Arizona, California, Nevada, Colorado, New Mexico, and Oregon.

**Dudley** (pop. 300,400) is a local government district in West Midlands, England. It includes the towns of Dudley, Halesowen, and Stourbridge. Dudley is a centre of metal industries. Other products include boilers, bricks, chemicals, clothing, computers, glassware, leather goods, printing, and tiles. Dudley became important in the 1700's and 1800's after large deposits of coal, iron ore, limestone, and refractory clay were discovered nearby.

**Dudley, Robert.** See **Leicester, Earl of**.

**Duel** is a form of combat between two armed persons. It is conducted according to set rules or a code, and it is normally fought in the presence of witnesses. From early times to the 1800's, men of high rank settled personal quarrels with weapons. They generally used swords or pistols. Duels resulted from disputes over

property, charges of cowardice, insults to family or personal honour, and cheating at cards or dice.

The duel probably originated in the custom of Germanic *judicial combat*, a method of administering justice. In judicial combat, the accused person challenged the accuser to a trial with weapons. The gods were supposed to give victory to the innocent person. Queen Elizabeth I of England was the first to abolish the duel as a form of justice. Later, all civilized countries abandoned the practice. But some private duels are still fought.

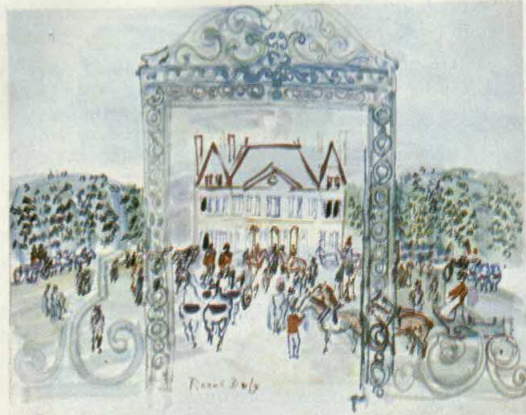
Some duels were more deadly than others. About 1800, French honour was satisfied by wounds, but the American duelling code at that time demanded death. The phrase *to give satisfaction* could mean either that blood must be drawn, or that one of the contestants must die. At other times it meant only that the challenged party had faced his enemy's fire.

The man challenged had his choice of weapons. The sword became the main duelling weapon in England and France. Duellists generally used pistols in America. Each duellist chose a friend who was called his *second*, and a surgeon usually attended. To avoid the police, the meeting usually took place in a forest clearing at day



The duel above shows German students in combat in 1895. The swords they used were typical duelling weapons.





Dufy's *Le Haras du Pin* shows the bright colours, sketchy details, and cheerful subject matter that typified his work.

break. When duellists used pistols, they usually stood at an agreed distance and fired on command.

**Du Fay, Charles François.** See Electricity (Experiments with electric charges and currents).

**Du Fresne, Marion** (1726-1772), was a French explorer. Du Fresne was the first European to see and describe the now extinct Tasmanian Aborigines.

In March 1772, Du Fresne examined the coast of Van Diemen's Land (now Tasmania) while in command of the ships *Mascarin* and *Marquis de Castries*. When he went ashore, he met a group of Tasmanians who appeared friendly, but who later hurled spears at his men. Du Fresne then crossed the Tasman Sea to New Zealand, where he was killed by the Maoris.

**Du Fu** (712-770) was one of China's greatest poets. He called himself Zi Mei. Later generations called him "the wise poet". His poetry reflects the troubled times in which he lived when the Tang Dynasty was in decline.

He was born in Gong County, Henan Province. In 755, the rebellious army of An Lushan disrupted the peaceful lives of the Chinese people and caused extreme personal hardship to Du Fu, who experienced hunger and poverty. His concern for his country and its people, and his own personal hardships, helped him to create a great number of immortal poems.

His main works include the epic poems "The Army Carts," "Song of a Beautiful Lady," "Three Officials," and "Three Farewells." His poetry is written in a gloomy but powerful style which is moving and obviously sincere. More than 1,400 of his poems still survive.

**Dufy, Raoul** (1877-1953), was a French artist best known for his lively, decorative paintings. Dufy used bright colours and a simple style to portray a happy, carefree world. His subjects included landscapes, festivals, horse races, and figures. Dufy also illustrated books and made woodcuts. He also designed fabrics, tapestries, and theatre costumes and sets.

Dufy was born in Le Havre. In 1900, he settled in Paris, where he painted briefly in the impressionist style. Dufy first attracted attention when he exhibited brightly coloured pictures with the fauves (see *Fauves*). He then came under the influence of cubism but found that style too severe. By 1920, Dufy had developed his own style.

**Du Gard, Roger Martin.** See Martin du Gard, Roger.

**Dugite** is a large venomous snake from southwestern Australia. Dugites are the most common dangerous snakes around Perth. They are closely related to *brown snakes* of eastern Australia. Dugites grow to a length of about 1.5 metres. They are dull greenish-brown with black scaly backs.

**Scientific classification.** Dugite belongs to the Elapidae family. It is species *Pseudonaja affinis*.

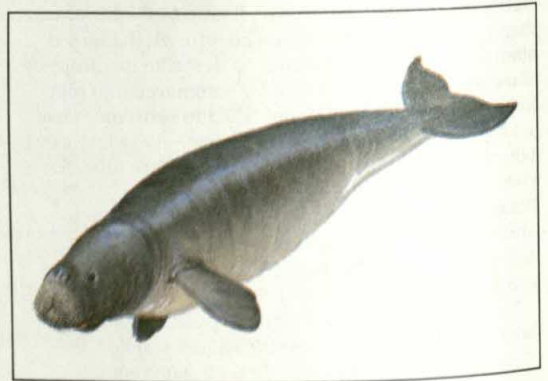
**Dugong** is a plant-eating mammal that lives in the shallow, warm coastal waters of the Red Sea and the Indian Ocean, as far south as Australia. The dugong has a blunt, rounded snout with a bristly upper lip.

The whalelike body has a notched tail. The dugong uses its flippers to swim and to push sea grass near its mouth. Most dugongs are brownish or greyish in colour. The male has two long upper tusks, and the ends of the upper jaw bend downwards. The female gives birth to one calf at a time. Dugongs may grow about 3 metres long and weigh up to 300 kilograms. Stories about mermaids may have started when sailors first saw dugongs.

Since the early 1900's, the dugong population has sharply declined. Laws protect the species in many areas. But many people still hunt the dugong for its hide, meat, and oil.

**Scientific classification.** The dugong belongs to the order Sirenia, family Dugongidae. It is *Dugong dugon*.

See also *Manatee*; *Sea cow*; *Sirenia*.



The dugong is a rare sea mammal.

**Dugout.** See *Boating* (Early boats); *Ship* (picture: Pre-historic and ancient Egyptian ships).

**Duigan, John** (1882-1951), a pioneer Australian aviator, designed and built the first Australian-made aeroplane. He flew it on July 16, 1910, for a distance of 9 metres. He made 26 more flights in the aircraft, which was a biplane powered by a 15-kilowatt engine built in Melbourne. Duigan was born at Terang, in Victoria, and later trained as a pilot and engineer in London.

**Duisburg** (pop. 518,260) is a trading and manufacturing city in the Ruhr region of Germany (see *Germany* [political map]). It is the largest inland port of western Europe. The city is built on the point where the Ruhr River flows into the Rhine and is connected with north German ports by the Rhine-Herne Canal. It is a gateway to the factories and mineral deposits of the Ruhr region.



Duisburg has long been important in German industrial life. The city produces iron and steel, chemicals, silks and woollens, soap, and tobacco.

**Dukas, Paul Abraham** (1865-1935), was a French composer, music teacher, critic, and editor. He became best known for *The Sorcerer's Apprentice* (1897), written in a lively symphonic form called a *scherzo*. Dukas was a master of orchestration. He wrote music of great clarity and could produce a fine variety of tone colours from different combinations of instruments.

Dukas was born in Paris. He taught at the National Conservatory of Music in Paris for several years. He also served as a music critic and prepared for publication and performance works by such composers as Ludwig van Beethoven, François Couperin, Jean Philippe Rameau, and Domenico Scarlatti. Dukas composed only a few works in addition to *The Sorcerer's Apprentice*. They include the overture *Polyeucte* (1891), *Symphony in C* (1897), the opera *Ariadne and Bluebeard* (1907), and the ballet *The Peri* (1912).

**Duke** is a European title. It comes from the Latin word *dux* (leader), and is the title next highest to *prince*. In England, there are few dukes outside the royal family, where the sons have the title of Royal Duke. The wife of a duke is a *duchess*, the oldest son is a *lord* with the rank of *marquess*, and younger sons and daughters are called *lords* and *ladies*.

**Duke-Elder, Sir William Stewart** (1898-1978), a Scottish ophthalmologist, became a leading authority on eye diseases and eye surgery. He was surgeon-oculist to Edward VIII, George VI, and Elizabeth II. He instigated the building of the eye hospital of St. John in Jerusalem, to combat trachoma.

Duke-Elder was born at Tealing, in Tayside Region, Scotland.

**Duke of Edinburgh's Award** is an international character-building scheme for young people first suggested in 1954 by the Duke of Edinburgh, husband of Queen Elizabeth II (see **Philip, Prince**).

The scheme is divided into three levels—the *Gold Award*, *Silver Award*, and *Bronze Award*. Young people between the ages of 14 and 25 may enter the scheme. To qualify for the certificate and badge given with each award, young people have to reach high standards in four out of five sections.

The *Service* section involves such work as first aid, mountain rescue, and youth leadership. The *Expeditions* section involves journeys requiring physical effort. The section called *Interests* requires the taking up of a new hobby or activity for a minimum of 6 months. The *Physical activity* section involves sporting activities. The *De-*

*sign for living* section involves learning about setting up a home.

A *pilot* (test) scheme for boys was launched in 1956 and a similar pilot scheme for girls was started in 1958. The full scheme for the Duke of Edinburgh's Award began in 1960.

**Dukenfield, William Claude**. See **Fields, W. C.**

**Dukes, Alan** (1945- ), an Irish Fine Gael politician, was leader of his party from 1987 to 1990. Dukes had previously held office in Fine Gael-Labour coalition governments. He was minister for agriculture from 1981 to 1982, minister for finance from 1982 to 1986, and minister for justice from 1986 until his party lost the election in 1987. Before entering Dáil Éireann in 1981, he was an economist and consumer affairs expert.

Dukes was born in Dublin and attended University College, Dublin.

**Dukhobors**. See **Doukhobors**.

**Dulbecco, Renato**. See **Nobel Prizes** (table: Nobel Prizes for physiology or medicine—1975).

**Dulcimer** is a stringed musical instrument played with wooden hammers. The hammered dulcimer has from 42 to 72 metal strings stretched across a flat, wooden box, which is usually trapezoid-shaped.

The Appalachian, or mountain, dulcimer is a different instrument. It is shaped like an hourglass or a teardrop and is held on the player's lap. It has three or four strings, which the player plucks or strums with one hand. The musician controls the pitch by pressing the strings down with the other hand.

The hammered dulcimer is found in many parts of the world, including Asia, Europe, and North America. Its history is well documented back to the mid-1400's. European immigrants brought the instrument to the United States in the 1800's. The hammered dulcimer gained new popularity during the American folk music movement of the 1960's.

See also **Zither**.

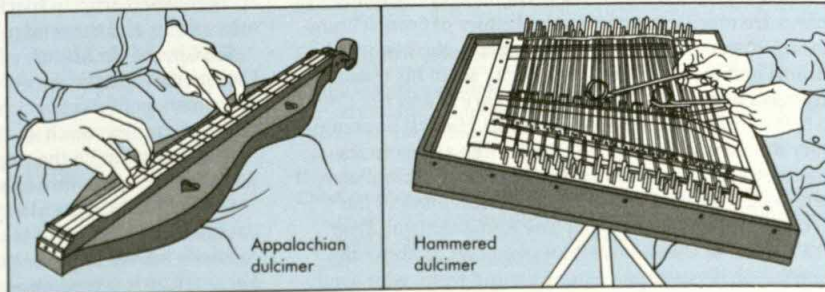
**Duluth** (pop. 85,493) is a city in northeastern Minnesota in the United States. It lies on the western shore of Lake Superior and St. Louis Bay. Duluth lies on a steep slope rising about 240 metres above Lake Superior.

Duluth is a transportation centre for products of the upper Midwest. Iron ore and coal are the chief products shipped from Duluth to other parts of the United States. Grain is the main international export.

**Dulwich** is a residential district in Southwark, in south London, England. Dulwich College is a leading independent school, founded by the actor Edward Alleyn in 1619. The college has an art gallery with an outstanding collection of paintings.

### Types of dulcimers

The *Appalachian dulcimer* has three or four strings and is played with the fingers. The *hammered dulcimer* commonly has from 42 to 72 metal strings that are stretched across a trapezoid-shaped box. The player strikes the strings with curved wooden hammers.





**Duma**, officially called the State Duma, was the lower house of the Russian legislature in the early 1900's, during the reign of Czar Nicholas II. Nicholas wanted to rule Russia with supreme authority. But Russian liberals demanded an elected legislature to approve laws and taxes. The Russian Revolution of 1905 threatened the czar's government and forced him to grant the liberals' demand.

The czar created the Duma in 1906, making it part of a two-house legislature. The State Council, which had been an advisory body to the czar, became the legislature's upper house. Nicholas feared democracy, and so he required that the Duma be indirectly elected in a system that favoured people who owned large amounts of property. Women could not vote. The czar appointed half of the State Council's members. The other half were elected by landowners, nobility, clergy, businessmen, and university professors. Laws and taxes had to be approved by the czar, the State Council, and the Duma.

The first Duma, which opened in 1906, was too radical for Nicholas, and he disbanded it. The second, elected in 1907, was even more hostile to the czar, and he soon dismissed it. Nicholas changed the election procedures in June 1907 to further strengthen the role of people with property. As a result, the third Duma was more conservative, and it served a full term, from 1907 to 1912. It often criticized Nicholas but worked with him on agricultural reform and public education.

The fourth Duma, elected in 1912, attacked the czar's conduct of World War I (1914-1918) and sought more power for itself. It helped bring about Nicholas' *abdication* (resignation from the throne) in March 1917. But the fourth Duma had little support among the people and was dissolved in October 1917 without completing a full term. In November 1917, Communists gained control of Russia and abolished the Russian legislature.

In 1993, Russia adopted a new constitution that created a 450-member State Duma. This body is the lower house of a national legislature known as the Federal Assembly.

See also **Nicholas II** (of Russia); **Russia** (Government). **Dumas, Alexandre, père** (1802-1870), was a French novelist and playwright. His son was the French author Alexandre Dumas *fils* (son). *Père* means *father* in French. Dumas chose unusual real characters for his novels and plays. He often used their memoirs for historical detail and changed their lives into exciting tales of adventure.

Dumas is best known for his famous romantic novels *The Three Musketeers* (1844) and *The Count of Monte Cristo* (1844-1845). Dumas continued the story of *The Three Musketeers* in *Twenty Years After* (1845) and *The Viscount of Bragelonne* (1848-1850).

Although Dumas is best known for his novels, his plays are more important in the history of French literature. Dumas created two types of plays, the historical drama and the contemporary drama set in his own time. Dumas's historical plays include *Henry III and His Court* (1829) and *The Tower of Nesle* (1832). His first contemporary drama was *Antony* (1831). All three are melodramatic stories of passion and murder. These plays were among the earliest and most successful plays of the French romantic movement (see **Romanticism**). *Kean* (1836), one of Dumas's best-known plays, is about the English Shakespearean actor Edmund Kean, who lived



Alexandre Dumas  
the elder



Alexandre Dumas the  
younger

during the early 1800's. It explores the nature of dramatic genius and the actor's alienation from society. Dumas also wrote histories, travelogues, and memoirs. He was born in Villers-Cotterêts. His mother was a native of the Dominican Republic.

**Dumas, Alexandre, fils** (1824-1895), was a French writer. His father was the French novelist and playwright Alexandre Dumas *père* (father). *Fils* is the French word for *son*.

Dumas wrote both novels and plays, but his fame rests chiefly on his plays. His first play, *The Lady of the Camellias* (often called *Camille*), was a great success when performed in 1852. The tragic love story is set in the fashionable Parisian society of Dumas's time.

Dumas came to believe that plays should teach social and moral lessons. He defended the family in *The Wife of Claude* (1873), *Denise* (1885), and *Francillon* (1887). Although he attacked wickedness, he also asked forgiveness for those who repent—as in *The Ideas of Madame Aubray* (1867). His plays, therefore, have a preaching tone, unpopular with many readers today. But the plays are well-constructed and often witty, and give a good picture of French upper-class society of his time. Dumas was born in Paris.

See also **Dumas, Alexandre, père**.

**Du Maurier** is the name of a family of English writers, artists, and actors.

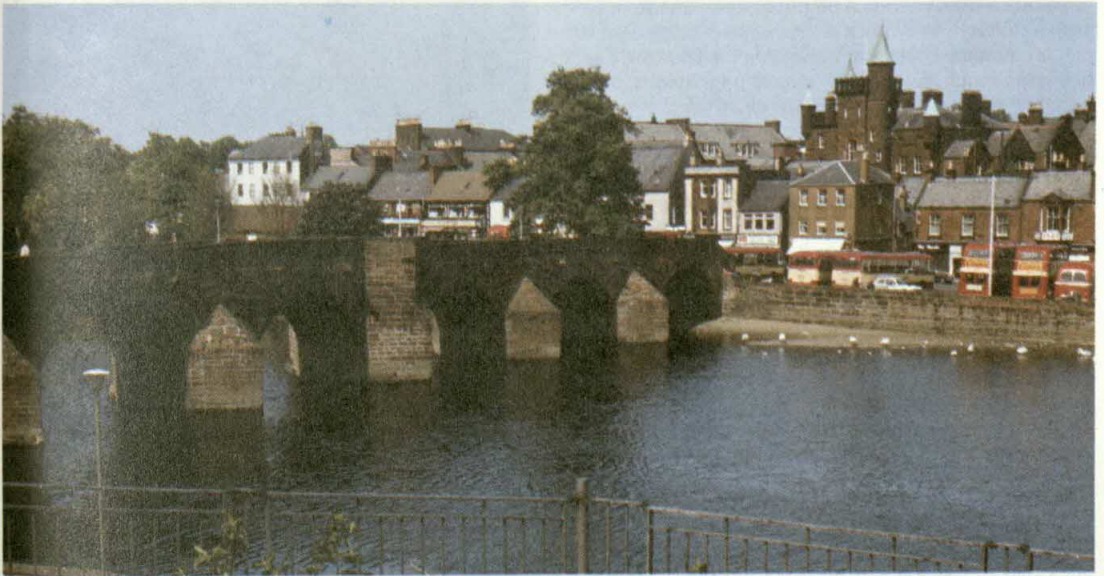
**George Louis Palmella Busson du Maurier** (1834-1896) is known chiefly for his novels *Peter Ibbetson* (1892) and *Tilby* (1894). *Peter Ibbetson* is a tale of two lovers who could meet only in their dreams. *Tilby* is a story about artists in Paris. Tilby, the heroine, is an artist's model under the influence of Svengali, a hypnotist. Through hypnotism, she becomes a great singer. But she loses her power when Svengali dies.

George du Maurier was born in Paris. He became an accomplished artist in black-and-white. He illustrated his own stories and those of many notable authors.

**Sir Gerald du Maurier** (1873-1934), the son of George du Maurier, was born in London. Gerald was an actor-manager who specialized in playing gentleman criminals in plays such as *Raffles* and *Bulldog Drummond*. He starred in the popular dramatic adaptation of *Tilby* and also played Shakespearean roles.

**Dame Daphne du Maurier** (1907-1989), the second daughter of Gerald du Maurier, wrote several popular romantic novels tinged with adventure or mystery. *Rebecca* (1938) is a suspense novel about a young wife's ex-





**Dumfries** is a historic town in the centre of Dumfries and Galloway Region. It lies on the River Nith, which is spanned by a bridge dating from the 1400s.

periences in a strange mansion that is dominated by the spirit of her husband's first wife.

Daphne du Maurier wrote two sea stories, *Jamaica Inn* (1936) and *Frenchman's Creek* (1941). Her other novels include *My Cousin Rachel* (1952), and *The House on the Strand* (1969). She also wrote *Myself When Young* (1977), an autobiography. Daphne du Maurier was born in London and was married to Lieutenant General Sir Frederick Browning. She became a Dame Commander of the British Empire in 1969.

**Dumbarton** (pop. 75,973) is a local government district in Strathclyde Region, Scotland. It includes the towns of Dumbarton, Alexandria, and Helensburgh. Dumbarton district is widely known for its Scotch whisky. Factories in Dumbarton and Alexandria also produce electricity generating equipment, kitchen furniture, and photographic materials. Many people who work in the industrial centres along the River Clyde live in the beautiful rural areas of the district. Helensburgh is a residential town and tourist centre.

**Dumbarton Oaks** was the name of an international conference held in August-October 1944 at Dumbarton Oaks, an estate in Washington, D.C. The name was also given to the proposals agreed upon at the conference. Thirty-nine delegates from the United States, Great Britain, and the Soviet Union met to discuss plans for the creation of an international organization to be called the *United Nations*. After six weeks of talks, the Soviet delegates, as agreed in advance, left, and delegates from Nationalist China replaced them.

The conference gave more attention to establishing ways to deal with "the maintenance of international peace and security" than it did to setting up agencies to handle economic and social problems. The delegates agreed that provision must be made for the peaceful settlement of international disputes and for the power to enforce the organization's decisions. The main

achievement of the conference was the planning of a Security Council for settling conflicts and enforcing UN resolutions dealing with matters of war and peace among member states. Many provisions of the Dumbarton Oaks Proposals were put into the UN charter.

See also **San Francisco Conference**; **United Nations** (The Dumbarton Oaks Conference).

**Dumfries and Galloway Region** makes up the most southerly part of Scotland. It is an agricultural area, with much beautiful moorland, forest, and coastal scenery. The region's largest town, Dumfries, is associated with the great Scottish poet Robert Burns, who spent his last years there. The engineer Thomas Telford and the historian Thomas Carlyle were both born in the region.

Dumfries and Galloway Region was formed in 1975, when Scottish local government was reorganized. Previously, the area had been three administrative counties, Dumfriesshire, Kirkcudbrightshire, and Wigtownshire.

### People and government

Dumfries and Galloway Region lies close to Ireland. As a result, the region has a number of Irish immigrants, particularly in its western parts. Many people from northern England have settled in the region. There has been for many years a tendency for people to move out of the region's agricultural areas to the towns.

### Facts in brief about Dumfries and Galloway Region

**Administrative centre:** Dumfries.

**Largest towns:** Dumfries, Stranraer, Annan, Dalbeattie, Castle Douglas, Lockerbie.

**Area:** 6,370 km<sup>2</sup>.

**Population:** 1991 census—147,064.

**Chief products:** *Agriculture*—beef, milk, mutton, timber, wool. *Manufacturing and mining*—boilers, coal, cranes, explosives, footwear, gloves, granite, hosiery, knitwear, plastics, processed food, sand and gravel.



**Local customs.** Annual pilgrimages are made to St. Ninian's Church in Whithorn. This custom originated in medieval times. It was made illegal in the late 1500's as being too much like Roman Catholic pilgrimages, but was then revived again almost 400 years later.

**Recreation.** Traditional sports are curling and quoits. International quoits matches are held at Annan. Dumfries and Stranraer have soccer teams in the Scottish League. Rugby football is less popular than soccer in the region. Golf is widely played. Fishing, hill walking, mountaineering, pony trekking and sailing are other popular activities, as are several agricultural shows and events.

**Local government.** Dumfries and Galloway Region is divided into four local government districts. They are *Annapdale and Eskdale*, the eastern part of the region; *Nithsdale*, which includes Dumfries and Sanquhar; *Stewartry*, which includes Dalbeattie, Dalry, and Kirkcudbright; and *Wigtown*, the western part of the region.

### Economy

**Agriculture and forestry.** Agriculture dominates the region's economy, especially sheep and cattle rearing. Lowland farms specialize in the production of milk. The farms are mainly arable, producing such crops as grass to feed cattle. Many farmers in the east grow potatoes.

The Forestry Commission has planted many trees on former rough grazing land on uplands. High rainfall and peaty soils encourage rapid growth of conifer trees, especially Sitka spruce, an important source of timber. Important forests include Ae, northeast of Dumfries, and Glen Trool Forest Park, north of Newton Stewart.

**Manufacturing and mining.** The region's main manufactures relate to textiles. Firms in Dumfries produce knitwear and hosiery. Factories at Annan produce socks and gloves, and a factory at Langholm produces men's clothing. At Drungans, on the outskirts of Dumfries, a factory produces explosives and plastics. Dumfries and Stranraer have factories that process agricultural products. Annan's factories produce boilers, cranes and turntables. Some coal and building stone are produced.

**Tourism** is important to the region. Its attractions include its scenery and its historic associations. The main tourist centres are Castle Douglas, Dumfries, Moffat, Newton Stewart, and Portpatrick.

**Transport and communications.** The A74 is the main road linking the region with Central Scotland to the north and connecting with the M6 leading to England to the south. The A75 is designated as a Euroroute, connecting Stranraer, which has ferries to Northern Ireland, to mainland Europe.

Railway lines connect Annan and Dumfries with Glasgow to the north and Carlisle to the south. Another line from Carlisle runs through Lockerbie and on to Edinburgh and Glasgow. The port of Stranraer is used to a small extent for coastal shipping. But its main function is as a terminal for the twice-daily ferry service to and from Larne in Northern Ireland. A railway line links Stranraer to Glasgow.

### Land

**Location and size.** Dumfries and Galloway Region is bounded to the north by Strathclyde Region and to the



**Gretna Green**, the "first village in Scotland," has been famous for runaway marriages for more than 200 years.

northeast by Borders Region. In the east, the region has a short boundary with England. The Solway Firth and the Irish Sea lie to the south and west. The region's longest distance is about 72 kilometres from north to south and 168 kilometres from east to west.

**Land features.** The northern and eastern parts of the region are a plateau covered with bleak moorland. The plateau rises to a maximum of about 840 metres. The land along the coast is lowlying and varies from rocky headlands to mud flats along the estuaries. The Mull of Galloway has cliffs 82 metres high.

**Rivers.** The main rivers are the Nith, Annan, and Esk. Three waterfalls in the region each have the name Grey



**Dumfries and Galloway Region**, in the south of Scotland, has a long coastline on the northern side of the Solway Firth.



Mare's Tail. The highest is near Moffat, in the northeastern part of the region.

**Climate.** The region's climate is the mildest in Scotland. It has cool summers and mild winters. Average annual rainfall is about 700 millimetres on the southwestern coast. In the high northern moorlands, annual rainfall is about 1,550 millimetres. The average summer temperature is about 15 °C in the southwest and 13 °C in the northeast. Average winter temperatures are 4 °C in the southwest and 0.5 °C in the northeast.

### History

Archaeologists have found many remains from the New Stone Age and Bronze Age in the region. The first Iron Age Celtic tribes moved to the area in about 500 B.C. They built hill forts, such as Burnswark, north of Annan. When the Romans moved into the area, they built a fort near Burnswark. St. Ninian brought Christianity to Whithorn in the late A.D. 300's.

During the 900's, the region was overrun by mixed Norse-Celtic invaders, the *Gallghaidel*. The invaders' name gave rise to the name Galloway. After David I became king of Scotland, the area was influenced by the Normans. The Normans founded abbeys and churches and built castles there.

The first overlords of the area were the Balliol family, followed in 1455 by the Douglas family. In the 1400's, Dumfries became a centre of textile manufacturing. The region had much fighting during the Reformation, the period of the Covenanters, and the Civil Wars.

Famous people associated with Dumfries and Galloway Region include John Paul Jones, a founder of the United States Navy, and the engineer Thomas Telford. Literary figures include Robert Burns and J. M. Barrie, who both had connections with Dumfries. Thomas Carlyle was born at Ecclefechan, north of Annan, and poet Hugh MacDiarmid was born at Langholm.

**Related articles in World Book include:**

Burns, Robert	Scotland, History of
Jones, John Paul	Telford, Thomas

**Dumfriesshire** was formerly a county in southwestern Scotland. It became part of the Dumfries and Galloway Region in 1975. See **Dumfries and Galloway Region**.

**Dumont D'Urville, Jules** (1790-1842), a French explorer and naval officer, made several voyages of exploration to Australia and New Zealand. He contributed much to the knowledge of the geography and plant life of both countries. One of his most notable voyages was his visit to New Zealand in 1827, in the warship *Astrolabe*, to explore uncharted parts of the coastline. He charted much of the western coast of the South Island and the eastern coast of the North Island.

**Dún Laoghaire** (pop. 54,715) is a town on the east coast of Ireland. It lies 11 kilometres southeast of Dublin (see **Ireland** [map]). *Dún Laoghaire* means *the fort of Laoghaire* in Gaelic. Laoghaire was an Irish king in the A.D. 400's. Dún Laoghaire is a residential area for people who work in Dublin. It is also a regional shopping centre and has some light industries. In addition, it is a centre of fishing, yachting, and other tourist activities. Ferries sail from Dún Laoghaire to Great Britain. The town has some Victorian architecture, but most of its buildings are modern.

Originally called Dunleary, the town was renamed Kingstown in 1821. Its development dates from the construction of its large harbour, begun in 1817. In 1834, a railway connected the town to Dublin. The town was named Dún Laoghaire in 1920.

**Dunant, Jean Henri** (1828-1910), a Swiss banker, was the founder of the International Red Cross. As a young businessman, he accidentally saw the battle of Solferino in 1859. He was shocked at the lack of care given the wounded. His book, *Recollections of Solferino* (1862), influenced the rulers of Europe tremendously, and in 1863 the Permanent International Committee was organized in Geneva. The next year, delegates of 16 countries agreed to the Geneva Convention for the treatment of wounded and prisoners (see **Geneva Conventions**). The United States ratified this agreement in 1882. Dunant



**Dún Laoghaire** is a major port in eastern Ireland with extensive harbour facilities. Ferries run regularly from Dún Laoghaire to Holyhead in Wales.





**Isadora Duncan** was strongly influenced by classical Greek culture. She usually danced barefoot in a flowing tunic.

went bankrupt and for 15 years his whereabouts was unknown. He was found in 1890, living in an almshouse, and in 1901 shared the first Nobel Peace Prize. He was born in Geneva.

See also **Red Cross** (History).

**Dunbar**, a sailing ship, was wrecked against the rocks on the outer South Head of Sydney Harbour in Australia, on Aug. 20, 1857. As she sailed northwards in a storm, her captain, James Green, thought she was further south of Sydney than she actually was. He sighted breakers, but had no room to change course, and the ship was dashed broadside against the rocks. Only 1 of the 122 persons aboard, James Johnson, survived. At an inquest, the captain and officers were cleared of blame.

**Dunbar, Battles of**, were fought in Scotland in 1296 and 1650. In 1290, Edward I of England was asked to decide the rightful king of Scotland. He chose John Balliol, but treated him as a *vassal* (dependent). Balliol defied Edward and in 1296 Edward invaded Scotland and defeated Balliol at Dunbar.

In the Battle of Dunbar of 1650, Oliver Cromwell defeated a Scots army under David Leslie. The Scots had proclaimed the son of the executed Charles I king as Charles II. Cromwell outmanoeuvred Leslie's larger army. The Scots had 3,000 dead, compared with fewer than 100 killed on Cromwell's side.

**Dunbar, William** (1465?-1530?), a Scottish poet, was noted for his mastery of words and imagery. About a hundred of his poems have survived, ranging from devotional poems, such as *Ane Ballat of Our Lady*, to outspoken and biting satires, such as *The Tua Mariit Wemen and the Wedo* (*The Two Married Women and the Widow*). His humorous verses, such as *The Ballad of Kynd Kittok*, are attractive and revealing. *The Lament for the Makaris* (poets) eulogizes his fellow-poet Robert Henryson.

Dunbar's birthplace was probably in Lothian Region. He studied at St. Andrews University and then became a Franciscan friar. Dunbar spent some years in France and returned to Scotland in about 1500. James IV of Scotland gave him a pension and later made him Rhymer of Scotland, a court poet.

See also **Scottish literature** (1300-1500).

**Duncan I** ( ? -1040), succeeded his grandfather, Malcolm II, as king of Scotland in 1034. William Shakespeare's play *Macbeth* portrays the events in his life in a distorted manner (see **Macbeth**). A series of unsuccessful efforts to expand his kingdom marked Duncan's reign. He also failed to rule all Scotland. Macbeth of Moray, who had a claim to the throne by right of his wife, killed Duncan in a battle near Elgin.

**Duncan, Isadora** (1877-1927), an American dancer, greatly influenced dancing in the 1900's. She rebelled against the rigid, formal training of classical ballet and created an individual form of expression. Influenced by the art of Greece, she often danced barefoot in a loose, flowing tunic. Duncan's dancing was inspired mainly by literature and classical music. She based her first dances on poetry. Duncan also used images and forms taken from painting and sculpture. She found further inspiration in nature, and she used dance to mirror natural forms such as waves.

Isadora Duncan was born in San Francisco. She gained great success in Europe, where she first performed in 1899. She lived abroad during most of her career and established schools of dance for children in France, Germany, and Russia.

See also **Dancing** (Modern dance).

**Duncan, Robert** (1919-1988), was an American poet. He was associated with a group of writers who worked during the 1950's at Black Mountain College, an experimental school in Black Mountain, North Carolina in the United States. Duncan was also a major figure in the *San Francisco Renaissance*, a cultural and artistic movement of the 1950's.

Duncan wrote hymns, lyrics, sonnets, and other forms of verse. He also wrote a verse play. Some of his works combine prose and poetry. His early works, in such collections as *The Opening of the Field* (1960) and *Roots and Branches* (1964), use religious and symbolic material and ancient mythology. Later, in *Bending the Bow* (1968) and in his collection *Groundwork Before the War* (1981), he attacked the Vietnam War. Duncan was born in Oakland, California.

**Dundalk** (pop. 26,581) is the county town and administrative centre of Louth, in the Republic of Ireland. It is situated on Dundalk Bay, midway between Dublin and Belfast, and is a seaport. Its chief products include beer,



**Dundalk** is a port and thriving industrial town in County Louth, on the east coast of Ireland.



clothing, computers, electronic components, furniture, processed food, tape recorders, television sets, and tobacco. Dundalk derives its name from the Irish *Dun Dealgan*, meaning *Dealga's Fort*. The town is the supposed birthplace of the legendary Cuchulainn (see *Cuchulainn*). The present town was founded by Bertram de Verdon, a Norman baron, in the late 1100's.

**Dundee** (pop. 165,548) is a local government district and seaport on the Firth of Tay, in Tayside Region, Scotland. World famous sweets and marmalade come from Dundee. Factories in Dundee produce carpets, electronic equipment and computers, and textiles. Other industries include marine engineering for the petroleum industry and publishing.

An iron railway bridge more than 3 kilometres long crosses the Firth of Tay at Dundee. A toll road bridge across the Tay to Newport, in Fife Region, was opened in 1966. Queen's College, Dundee, became the University of Dundee in 1967.

**Dune** is a mound or ridge of loose sand that has been deposited by the wind. Dunes are common in all sandy regions. They are found along coasts, near rivers and lakes, and in deserts. Dunes may be long and narrow or shaped like a crescent. Some have three or more ridges that extend from a high central peak. In some areas, large dunes reach heights of 300 metres.

Most dunes are found in large groups known as *dune fields*. Extremely large areas of dunes in the Sahara and other large deserts are called *sand seas*. Many dunes migrate across the land as the wind removes sand grains on one side of the dune and deposits them on the other side. Migrating dunes can block roads, bury houses, and destroy agricultural land.

Dunes State Park, at the southern end of Lake Michigan in the United States, has unusual dunes. Sand dunes along the coast of Australia include Fraser Island, which is the largest sand island in the world.

See also **Sahara** (picture: An oasis village).

**Dunedin** (pop. 109,503) is the seventh largest city of New Zealand. It is the most southerly of the country's main centres. It is located at the head of the Otago Harbour on the eastern coast of the South Island. For location see **New Zealand** (political map).

Most of the land around the city is hilly. But the main commercial and industrial areas, together with the uni-

versity campus and recreational and residential areas have all been reclaimed from the harbour.

**Economy.** Dunedin is the largest centre in the South Island for selling fine wool. Woollen mills are among the city's main industries. The Port of Otago, which includes Dunedin and Port Chalmers, is mainly an exporting port for wool, frozen meat, and processed meat products. Fruit growers from Central Otago send their produce to Dunedin for distribution to other parts of New Zealand and overseas.

**History.** The earliest inhabitants of the Otagou (Otago) area were the Kahui Tipua. Later other tribes invaded the district. By the time the British explorer James Cook arrived in Otago in 1776, only a few hundred Maori still lived in the Dunedin area. Most of them were in Waikouiti and Otagou, which became European whaling settlements in the early 1800's. Contact with European disease, such as influenza and measles, lessened the Maori population even more.

In the 1840's, the leaders of the Free Church of Scotland decided to start a settlement in New Zealand partly because of the economic depression in Scotland. They planned a settlement based on religious principles. In 1844, Frederick Tuckett, a surveyor, selected the present site of Dunedin. In 1848, the first settlers arrived in the *Phillip Laing* and the *John Wickliffe*. The leaders were Captain William Cargill and Thomas Burns. During the next three years, 18 other migrant ships arrived. By 1852, 2,000 settlers lived in Dunedin. The settlement struggled in its early years. But the Central Otago gold rushes, which began in 1861, transformed Dunedin into New Zealand's leading business centre. New Zealand's first university was founded in Dunedin in 1869. After 1900, Dunedin's commercial and industrial importance declined.

**Dunfermline** (pop. 125,529) is a local government district in Fife Region, Scotland. The district lies on the Firth of Forth and includes the manufacturing towns of Dunfermline and Inverkeithing.

Industries in the district include engineering, coach building, and the manufacture of clothing, electronics goods, and petrochemicals. Inverkeithing is important for its paper-milling industry. Rosyth, in the south of the district, has a naval dockyard.

**Dung beetle.** See **Scarab**.



**Dundee** is a busy port on the Firth of Tay in Tayside Region. A concrete road bridge carries traffic across the Tay between Dundee and Fife Region, to the south. The bridge, opened in 1966, is 2,245 metres long.





**Katherine Dunham** became known for her choreography of black dances from throughout the world. Dunham and her company danced on Broadway in *A Tropical Revue* (1943), above.

**Dungannon** (pop. 45,408) is a local government district in the south of Northern Ireland. Mixed farming is the main industry, and both beef and dairy cattle are important. Crops include barley and potatoes. Sand is quarried in the area. Local products include bricks, glassware, and synthetic fibres.

**Dunham, Katherine** (1912- ), a U.S. dancer and choreographer (dance composer), became noted for her interpretations of the dances of blacks of the West Indies and the United States. She made extensive studies of dances of Jamaica. In the late 1930's and early 1940's, Dunham was a dancer and choreographer in films and stage musicals. She organized her own dance company, touring the United States and Europe with ballets based on African and Caribbean ceremonial and folk dances. Dunham ran her own dance school.

Dunham was born in Chicago. She studied anthropology at the University of Chicago both as an undergraduate and a graduate student. Dunham described her experiences in Jamaica in *Journey to Accompong* (1946). Her autobiography, *A Touch of Innocence*, was published in 1959.

**Dunkerque** (pop. 73,120; met. area pop. 200,000) is a French seaport and industrial centre and the site of a dramatic Allied evacuation during World War II. Dunkerque—also spelled *Dunkirk* and *Dunquerque*—lies in northern France. For location, see **France** (political map).

Dunkerque has an excellent harbour and is one of the busiest ports in France. It is also a major centre for petroleum refining and steel processing. Other industries include food processing and ship repair.

Dunkerque was founded by Saint Eloi in the A.D. 600's. By the 1500's, it had become a leading French port. In late May of 1940—during World War II—Germany won control of Belgium from the Allies. On May 26, thousands of British and French troops, and some Belgian troops, began retreating from Belgium to Dun-

kerque. Germany attacked the city and it was badly damaged. But from late May until June 4, more than 800 vessels evacuated about 338,000 Allied troops from Dunkerque to England. The vessels included cruisers, destroyers, gunboats, minesweepers, fishing boats, motorboats, and yachts. The evacuation ranks as one of the best-planned military movements in history. It has been called the Miracle of Dunkerque. See also **World War II** (The invasion of the Low Countries).

**Dunkers.** See **Brethren, Church of the.**

**Dunlap, William** (1766-1839), has been called the father of American drama. He was the first professional playwright in America, the first to produce his own plays, and the first to champion the cause of the native dramatist. He was also the first to adapt plays from the French and German, and his *History of the American Theater* (1832) is the earliest account of the American stage. Of the 56 plays attributed to him, 27 are originals and 29 translations or adaptations. Dunlap's best-known original plays include *André* (1798), *Leicester* (1806), and *A Trip to Niagara* (1828).

Dunlap also wrote biographies and a valuable source book, *History of the Rise and Progress of the Arts of Design in the United States* (1834). He was also a successful painter. Dunlap was born in Perth Amboy, New Jersey.

**Dunlop, John Boyd** (1840-1921), a Scottish veterinary surgeon, patented the first commercially successful *pneumatic* (air-filled) tyre in Britain in 1888. His patent came 43 years after another Scot, Robert William Thomson, had taken out a similar patent in 1845. Dunlop's patent proved more successful than Thomson's because the price of India rubber had fallen, allowing it to be brought into general use. Dunlop made his first pneumatic tyres to replace the solid rubber tyres on his son's bicycle so that it would ride more comfortably. Dunlop's tyre was patented and tested in the United States in 1890. He sold his patent and company in 1896.

**Duns Scotus, John** (1265 or 1266-1308), was one of the greatest theologians and philosophers of the Middle Ages. His ideas on God, knowledge, salvation, and the nature of being influenced many thinkers of the late Middle Ages.

According to tradition, Duns Scotus was born in Duns, Scotland, and entered the Franciscan religious order as a youth. His most important work was the *Opus Oxoniense* (*Oxford Work*). The book grew out of lectures Duns Scotus presented at Oxford University on *The Four Books of Sentences*, an influential medieval theological book by Peter Lombard. Duns Scotus also produced commentaries on Aristotle's ideas on logic and wrote *Quaestiones quoddlibetales* (*Various Disputations*), which examines a variety of controversial philosophical and theological questions.

Duns Scotus also became known for his defence of the doctrine of the Immaculate Conception. According to this doctrine, the Virgin Mary was conceived free of original sin. His defence contributed to its recognition, centuries later, as an official Roman Catholic doctrine.

See also **Scholasticism** (History).

**Dunsany, Lord** (1878-1957), wrote more than 50 books, including collections of stories, a novel, and an autobiography. He is remembered today for his tales, and for such plays as *The Gods of the Mountain* (1911) and *A Night at an Inn* (1916).



Dunsany's best work is in his short pieces and all his writings tend towards the form of the ironic fable. His writings often deal in the supernatural, and he invented his own mythology—"heavens and earths, and kings and peoples and customs, just as I need them." Nevertheless, his works show the influence of Oriental, Biblical, and classical literature.

Lord Dunsany was born Edward John Moreton Drax Plunkett in London of Irish parents. He was also a noted sportsman and soldier.

**Dunstan, Donald** (1926- ), an Australian Labor Party politician, was premier of South Australia from May 1967 until his government fell in 1968. In 1970, Dunstan's party was reelected with a solid majority, with a platform for introducing many reforms and civil liberties.

Donald Allan Dunstan was born at Suva, in Fiji, and educated at St. Peter's College, Adelaide, and the University of Adelaide. He was elected as the member for Norwood in 1953. As attorney general and minister for Aboriginal affairs from 1965 to 1967, he introduced many antiracist laws and reformed others. Dunstan resigned as premier because of ill health in 1979.

**Dunstan, Saint** (909?-988), was an English religious reformer, statesman, and archbishop of Canterbury. He acted as an adviser to a number of kings of Wessex—a kingdom in southern England—including Kings Edmund, Edred, and Edgar. Dunstan also helped revive English monasteries by rebuilding them and by strengthening discipline among their residents. Many monasteries had been destroyed by the Danes, who had invaded England during the 800's. Dunstan also worked to unify England by helping make peace with Danes who lived in northern England.

Dunstan was born near Glastonbury in Somerset. About 943, King Edmund made him abbot of a monastery at Glastonbury. In 956, Dunstan was banished from Wessex by King Edwig, whose conduct Dunstan had criticized. But Dunstan returned to Wessex after Edgar gained power there. Edgar made Dunstan bishop of

London in 958 and archbishop of Canterbury in 959.

Dunstan's feast day is May 19.

**Duntroon**, in the Australian Capital Territory, is the site of the Royal Military College, which prepares cadets for careers as officers in the Australian Regular Army. An average of 100 cadets each year begin four years of academic and military training at the college, which contains the faculty of military studies of the University of New South Wales. Graduates of the college are commissioned as lieutenants and are awarded degrees in arts, science, or engineering. The college dates from 1911.

**Duodecimal numerals** form a numeration system based on 12. The Romans, to whom the number 12 was sacred, used the duodecimal system in dividing the foot and pound into twelfths and the year into months. The words *inch* and *ounce* come from a Latin word meaning *twelfth*. The system used by merchants in counting by the dozen and by the gross (12 dozen or 144) is called a duodecimal system. The word *dozen* comes from a Latin word meaning *twelve*. Some writers argue that a duodecimal system could be used more easily than the decimal system, because 12 has more factors than 10.

See also Numeration systems.

**Duodenum**. See Stomach.

**Duplicate bridge**. See Bridge (Duplicate bridge).

**Du Pont de Nemours** is the name of a famous American family from Delaware that established the chemical firm of E. I. du Pont de Nemours & Company. Several members of the family have been active politically.

**Pierre Samuel du Pont de Nemours** (1739-1817) was a French economist and statesman who went to the United States in 1800. He studied medicine, but turned to economic affairs as a result of national pressures in France. He was a close associate of many well-known French economists of his time, and became a notable author in economics.

Du Pont was caught in the conflicts following the French Revolution, and fled to the United States. President Thomas Jefferson recognized his ability, and asked him to prepare a plan for national education. When



The escape from Dunkerque in 1940 became one of the most famous events of World War II. Allied ships and other vessels carried nearly 350,000 retreating troops to safety in England.



France became more peaceful, Du Pont went back to his home country. He was born in Paris.

**Éleuthère Irénée du Pont** (1771-1834), the son of Pierre Samuel du Pont, founded the gunpowder works that formed the beginning of the present-day Du Pont Company. He was born in Paris, and ran his father's printing plant until the French Revolution. He fled to the United States with his father and older brother and their families. Du Pont later saw the need for a gunpowder plant in the new republic. In 1802, he selected a site along Brandywine Creek approximately 6 kilometres from Wilmington, Delaware.

**Thomas Coleman du Pont** (1863-1930), great-grandson of Éleuthère Irénée du Pont, made a fortune at an early age in the coal and iron business. He served as president of the Du Pont Company from 1902 to 1915. It was under his leadership that the wide business interests of the family were combined under the present corporate charter of the E. I. du Pont de Nemours Powder Company. Du Pont was active in American politics both on the state and national level. A Republican, he was appointed U.S. senator from Delaware in 1921 to fill a vacancy. He served until the election of 1922. He was elected to the Senate in 1924, but resigned in 1928. He was born in Louisville, Kentucky.

**Du Pré, Jacqueline** (1945-1987), was a brilliantly gifted British cellist. She is best remembered for her emotionally deep interpretation of the *Cello Concerto* of Sir Edward Elgar. Du Pré was born in Oxford and studied at the Guildhall School of Music, London. In 1967 she married the renowned pianist and conductor Daniel Barenboim. She became ill with multiple sclerosis, and her performing career ended in 1972.

**Durack** is the name of an Australian family of pastoralists who pioneered cattle country in western Queensland and in the Kimberley district of Western Australia.

**Patrick Durack** (1834-1898) and his brother **Michael Durack** (1845-1895) founded Thylungra station on Cooper Creek in western Queensland. After the droughts of the 1870's, they set out in May 1883, with other members of the family, to drive 8,000 cattle overland to the Ord River, in Western Australia. They arrived 30 months later and opened up new grazing lands.

**Michael Patrick Durack** (1865-1950), son of Patrick, was a member of the Legislative Assembly for Kimberley from 1917 to 1924. His two daughters, **Mary Durack** (1913-1994), a writer, and **Elizabeth Durack** (1916- ), an artist, collaborated in producing books on Aboriginal subjects. Mary Durack also wrote *Kings in Grass Castles* (1959), a family history.

**Duralumin** is a term for any one of a group of aluminium-copper alloys. A typical duralumin alloy is made up of about 95 per cent aluminium, 4 per cent copper, 0.5 per cent magnesium, and 0.5 per cent manganese. Some duralumin alloys also include a small amount of silicon or iron. Duralumin has strength and lightness and is used in making aircraft parts and heavy-duty equipment.

**Durante, Jimmy** (1893-1980), was an American entertainer. Born in New York City, he began his career playing the piano. His comic singing and clowning won him fame in vaudeville, the theatre, night clubs, the cinema, radio, and television. Durante made his large nose the object of many jokes and became known as the *Schnoz-*

*zle*. In 1951, he received a Peabody Award for television entertainment. The entertainer's biography, *Schnozzola: The Story of Jimmy Durante*, was written by Gene Fowler.

**Durban** (pop. 715,669; met. area pop. 1,106,971) is the chief eastern seaport in South Africa. It is the largest city of Kwazulu-Natal and the third largest in South Africa (see Kwazulu-Natal). *Tekweni* is the Zulu name for the city. Durban lies on the Indian Ocean, and is a major port and tourist centre. For location, see South Africa (political map).

The city has a sunny, subtropical climate. Summers are warm and wet, and winters are mild. The Agulhas Current warms the coastal waters, and vegetation ashore is luxuriant. The city spreads around a large bay which forms an excellent natural harbour.

About half of Durban's people are of Asian origin. These are mainly Hindus with some Muslims and Christians. Durban has several Hindu temples and Muslim mosques. Alayan Temple is the largest and oldest temple in South Africa. The Juma Mosque is the largest mosque in the Southern Hemisphere.

About a third of Durban's population is of European origin. Many have British ancestors, and some have links with Afrikaner settlers. People of African ancestry make up about 15 per cent of the population. Most Africans are Zulu-speakers.

The University of Natal, founded in 1949, has one of its campuses in Durban. The University of Durban-Westville was opened in 1973. Durban's Playhouse Theatre complex is a venue for drama, opera, and ballet.



Jimmy Durante



Durban's Town Hall shows the strong influence of European architecture on the city's early settlers.



Business in and around the harbour forms the hub of Durban's economy. Port facilities handle 25 million metric tons of cargo a year. Bulk cargoes include coal, grain, manganese ore, and sugar. Sugar is one of the mainstays of Kwazulu-Natal's economy. Important by-products of sugar include chemicals, fuel, paper, wall-board, and yeast.

Durban also depends heavily on the tourist industry. The city, with its pleasant climate, is South Africa's most popular coastal resort. It serves more than a million visitors each year.

The first recorded European visitor to the area was the Portuguese navigator Vasco da Gama. Arriving there on Christmas Day, 1487, he named the area Natal. By the end of the 1700's, people from the Lala and Luthuli tribes had settled, along with a few Europeans. In 1823, a group of ivory traders from the Cape established a trading settlement. They called it Port Natal. The settlement grew, and in 1834 was renamed Durban, after Sir Benjamin D'Urban, governor of the Cape. Durban achieved city status in 1935.

**Dürer, Albrecht** (1471-1528), was the most famous painter and printmaker in the history of German art. He also became famous as a scholar and author. Dürer was the first writer to describe the concept of artistic genius and he was the first to publish scientific literature in German.

Dürer's published works include books on geometry and perspective, civil defence, and the measurements of the human body. In his studies on artistic theory, Dürer tried to explain idealized beauty as well as ugliness, and differences in personality.

Dürer was born in Nuremberg. Between the ages of 13 and 40, he painted and drew a remarkable series of revealing self-portraits.

Dürer's most famous oil paintings include *Self-Portrait* (1500); an altarpiece for the Church of the Germans in Venice, called *The Feast of the Rose Garlands* (1506); and *Four Apostles* (1526), painted for the Nuremberg city hall. One of his most popular pictures is a brush drawing called *Praying Hands* (1508), which was a study for part of an altarpiece for a church in Frankfurt.

Dürer was the first major artist to paint realistic water colours from nature. The best known of his nature studies include several landscapes done in the Austrian Alps and Italian Alps and scenes from the area around Nuremberg.

As a printmaker, Dürer created many woodcuts, most dealing with religious subjects. Some of his engravings portray traditional Christian subject matter. Others picture Greek and Roman myths and allegories. In these prints, Dürer introduced idealized nude figures into German art. Dürer was also one of the first printmakers to experiment with etching.

For examples of Dürer's work, see **Painting** (What do painters paint?); **Bookplate**; **Engraving**; **Four Horsemen of the Apocalypse**; **Horse** (Horses in history).

**Durham** is the county in the northeast of England where, in 1825, George Stephenson opened the first public steam railway in the world. The county is known for its traditional coal mining industry and for the majestic Norman cathedral and castle in Durham city. Durham's area and population were reduced in 1974, when local government in England was reorganized.



**Albrecht Dürer** was an outstanding painter. His painting *The Nativity* (above) is the central panel of an altarpiece, completed in 1503. It shows the influence of the Italian Renaissance. Dürer's self-portrait (left) dates from 1500.

**Legend and customs.** Durham has many legends about monsters and dragons. They include the legend of the Lambton worm, set in the time of the Crusades (see **Crusades**). A member of the Lambton family was given advice by a witch on how to kill a monster called the Worm. In return for her help, he promised to kill the first living being he met after killing the monster. But after he slaughtered the monster, his father came running to meet him, and Lambton did not carry out his promise. As a punishment, the witch declared that for

#### Facts in brief about Durham

**Administrative centre:** Durham.

**Largest towns:** Darlington, Durham city, Consett, Bishop Auckland, Chester-le-Street, Peterlee, Newton Aycliffe.

**Area:** 2,429 km<sup>2</sup>.

**Population:** 1991 census—589,800.

**Chief products:** *Manufacturing*—ball bearings, bridges, carpets, chemicals, clothing, construction engineering, food products, glass, microchips, pharmaceuticals, plastics, rubber, toys. *Mining*—coal, fluorspar, limestone, sand and gravel. *Agriculture*—dairy products, market gardening, potatoes, poultry, sheep, wheat.



many generations, no Lambton would die in his bed. The people of Durham have several versions of the Lambton legend.

**Recreation.** The ancient Shrovetide football game is still played each year at Sedgefield. The goals are about 400 metres apart, and the game sometimes lasts for hours. Horses play an important part in life at Sedgefield. Sedgefield has a horse-racing course, and fox hunting is a popular local sport.

Darlington has a team in the Football League. Other popular sports include sailing off the coast and boating on the River Wear. Each June, Durham holds a regatta, which is believed to be the oldest British regatta. Facilities for freshwater fishing are good in reservoirs and the upper reaches of the Wear. Sea fishing is a popular activity at Seaham, which also has good beaches.

Music plays an important part in people's lives in Durham. The county has many brass bands and choral societies. Durham city is an important cultural centre. Among its attractions is an annual festival of contemporary music.

**Local government.** Durham is divided into seven district councils for local government: *Chester-le-Street*; *Derwentside*, which includes the town of Consett; *Durham*, which centres on the city of Durham; *Easington*, which includes all the coastal parts of the county; *Sedgefield*; *Teesdale*, which includes the county's south-western parts; and *Wear Valley*, which includes the county's central and northwestern parts.

The Crown Court sits at the city of Durham. The Durham Constabulary, which polices the county, has its headquarters in Durham city.

**Manufacturing.** The main manufacturing centre is Darlington, in the south of the county. It has long pro-



**Durham** is a county of harsh, open countryside to the west contrasting sharply with crowded industrial areas near the coast.

duced railway equipment, and today other forms of engineering are becoming important.

Traditional industries in the city of Durham are carpet making and organ building, and both are still flourishing. In Chester-le-Street, the local industries include brickmaking, engineering, joinery, and printing.

Barnard Castle developed a leather industry in the 1600's. Today, some of the town's workers produce chamois leather gloves or weave woollen cloth. The town also produces antibiotics.



**Durham Cathedral and Castle**, both fine examples of Norman architecture, dominate the city of Durham from their position on a steep hill overlooking the River Wear.

J. Allan Cash Photolibrary



Bishop Auckland has a trading estate that has attracted new industries, including flour milling, engineering and printing. Shildon has a railway wagon works and factories producing clothing, nylon carpets, and synthetic furs.

Aycliffe (also known as Newton Aycliffe) is a *new town* (a community planned to attract new industry). Its products include axles and gears, and components for radar, radio, and colour television. Workers in another new town, Peterlee, produce electrical equipment, electronic components, knitwear, and potato crisps.

**Mining.** Although the coal-mining industry has declined, it still provides many jobs in eastern Durham. The county also produces fluorspar, which is used in the steel and chemical industries.

**Agriculture.** The Easington area has much mixed farming. Crops include wheat, potatoes, and other root vegetables. Some farmers keep pigs or poultry. Others do market gardening or grow glasshouse crops. The area around Sedgfield has much dairy farming. In the hill and moorland farms of western Durham, farmers mainly keep sheep. They also keep a few dairy cattle.

**Transport and communications.** The main railway line from London to Newcastle upon Tyne passes through Darlington, Durham, and Chester-le-Street. Branch lines link Darlington with Bishop Auckland and with Middlesbrough in the county of Cleveland. The M1 motorway runs through eastern Durham.

The airport at Middleton St. George, near Darlington, has regular flights to London. Docks at Seaham export commodities, such as scrap iron to Spain and agricultural lime to Scotland.

Darlington has two daily newspapers. A number of the towns publish their own local weekly newspapers. A community radio station broadcasts from Aycliffe.

**Location and size.** County Durham is bordered on the north by Northumberland and Tyne and Wear, on the east by the North Sea and Cleveland, on the south by North Yorkshire, and on the west by Cumbria. The greatest distance measured from west to east is about 72 kilometres. The greatest distance measured from north to south is about 53 kilometres.

**Land regions.** The county comprises four land regions—the Western Hills and Dales, the East Durham Plateau, the Wear-Tyne Lowlands, and the Tees Plain.

**The Western Hills and Dales** lie in the Pennines. The hills rise to 730 metres above sea level and are largely moorland.

**The East Durham Plateau**, reaching a height of 180 metres above sea level, is triangular in shape. Its narrowest part lies in the centre of the county at the foot of the Western Hills. From this point, the plateau widens towards the coast.

**The Wear-Tyne Lowlands**, beginning in the centre of the county, lie between the Western Hills and the East Durham Plateau. They run northwards into the county of Tyne and Wear.

**The Tees Plain** is an area of rolling lowlands that runs from the southern end of the East Durham Plateau south to the Tees and the border with North Yorkshire.

**Lakes and rivers.** The county has two main rivers: the Tees and the Wear. The Tees forms the county's southern border. On its 159-kilometre course, it passes over two waterfalls, Cauldron Snout, and High Force,

which is the highest waterfall in England. The Wear runs 113 kilometres eastwards across the county. It passes Bishop Auckland and Durham and reaches the sea at Sunderland, in Tyne and Wear.

**Climate** in the county is temperate. In the east, average rainfall is less than 635 millimetres a year. The Western Hills is the wettest area, with more than 1,520 millimetres of rain. In January, the coldest month, temperatures average 3° C. July is the warmest month, with temperatures averaging about 15° C.

## History

Before the Roman occupation, the county was remote and isolated. The Romans occupied Durham in about A.D. 80. They built several forts and a road through the county from York to Scotland. After the Romans left, Vikings invaded the area.

William the Conqueror and later English kings made Durham a county palatine in an attempt to stop Scottish border raids. Durham's medieval prince-bishops ruled like kings until the Tudor monarchs took away much of their power. Each prince-bishop had his own army, barons, mint, and prisons.

Few people lived in Durham until the development of the coal-mining and shipbuilding industries there in the early 1800's. In the 1830's, the county became a centre of the Industrial Revolution (see **Industrial Revolution**).

Durham is associated with many famous engineers and builders, such as the railway engineer George Stephenson (see **Stephenson** (George)).

**Related articles** in *World Book* include:

Cleveland	Durham, Earl of
Darlington	Tyne
Durham (city)	Tyne and Wear

**Durham** (pop. 85,000) is a city and local government district in the county of Durham, England. Traditional local industries such as carpet making have been supplanted by the making of plastics, synthetic fibres and textiles, furniture, and clothing. Engineering, printing, and bottling beer are also important industries. Durham's historic buildings include its cathedral and castle. It also has a museum of oriental art. The University of Durham was founded in 1832.

**Durham, Earl of** (1792-1840), was a British political leader and governor general of Britain's Canadian colonies. A government report that he wrote on Canada in 1839 is an important document in Canadian history.

Durham served as governor general of Canada for only four months. He resigned when the British Parliament disagreed with his mild punishment of the rebels.

After returning to Britain from Canada, Durham presented his *Report on the Affairs of British North America*. The report urged the government to unify Upper and Lower Canada and to give the Canadian colonies self-government in local affairs. Unification of the two Canadas took effect in 1841. Durham was born John George Lambton in Cowes, on the Isle of Wight, England.

**Durian** is a tree which bears edible fruit. Durian trees grow up to 30 metres tall and the fruit are green and 25 centimetres across with a hard, prickly shell. The fruit is popular in Malaysia and Thailand.

Durian trees are widely grown in Malaysia and Thailand but are rare in other countries. This is partly be-



cause the seeds will grow only if they are planted soon after they are taken from the fruit. The fruit is usually left until it falls off the trees. At this point it is not fully ripe. It tastes sweet and slightly like garlic. After just a few days on the ground, the fruit ripens completely and develops a very strong smell.

**Scientific classification.** The durian belongs to the bombax family, Bombacaceae. It is *Durio zibethinus*.

**Durkheim, Émile** (1858-1917), was a French sociologist. His theories and writings helped establish the foundations of modern sociology. Durkheim disagreed with most social theorists of the late 1800's because they thought that individual psychology was the basis of sociology. Durkheim regarded sociology as the study of the society that surrounds and influences the individual. Durkheim explained his theories in his book *The Rules of Sociological Method* (1895).

In *The Division of Labour* (1893), Durkheim developed the theory that societies are bound together by two sources of unity. He called these sources *mechanical solidarity* and *organic solidarity*. Mechanical solidarity refers to similarities that many people in the society share, such as values and religious beliefs. Organic solidarity results from the division of labour into specialized jobs. Durkheim believed that the division of labour makes people depend on one another and thus helps create unity in a society.

Durkheim studied thousands of cases of suicide to demonstrate his theory that a person commits suicide because of the influence of society. He explained this theory in *Suicide* (1897).

Durkheim was born in Épinal. He studied at the École Normale Supérieure in Paris and taught sociology at the University of Bordeaux and at the Sorbonne in Paris.

**Durrell, Gerald** (1925-1995), was a British naturalist and author. He was the brother of Lawrence Durrell. Gerald Durrell was best known for his work in wildlife preservation and his books on animals. Durrell described his experiences with animals in light-hearted stories.

Durrell was born in Jamshedpur, India, of British parents. In 1947, Durrell began a career of leading zoological expeditions. He travelled to Cameroon, Madagascar, Mexico, Australia, and other places to collect animals for zoos in Europe and North America. His first book was *The Overloaded Ark* (1953).

In the mid-1950's, Durrell decided to create his own zoo. He opened his zoo in Jersey, in 1959, and dedicated it to breeding endangered species. This zoo is known as the Jersey Zoological Park, and it is operated by the Jersey Wildlife Preservation Trust. Durrell wrote more than 30 books, including *A Zoo in My Luggage* (1960) and *The Stationary Ark* (1976). He also wrote *The Amateur Naturalist* (1983) with his wife, Lee.

**Durrell, Lawrence** (1912-1990), was a British novelist, travel writer, and poet. He was the brother of Gerald Durrell. Lawrence Durrell was best known for his series of four novels called *The Alexandria Quartet*. The *Quartet* consists of *Justine* (1957), *Balthazar* (1958), *Mountolive* (1959), and *Clea* (1960). The novels are noted for their ornate language, unusual characters, and vivid descriptions of the Mediterranean Sea and the city of Alexandria, Egypt, during the late 1930's. Durrell described a series of love affairs as viewed by the leading characters

with different perspectives on what makes up the truth of their experience.

Durrell was born in Darjeeling, India. He lived most of his life in the eastern Mediterranean. His first novel, *The Black Book* (1938), reveals the influence of his close friend, the American novelist Henry Miller. Durrell described life on the islands in and near Greece in *Prospero's Cell* (1945), *Reflections on a Marine Venus* (1953), *Bitter Lemons* (1957), and *The Greek Islands* (1978). He narrated a tour through the island of Sicily in *Sicilian Carousel* (1977). Durrell's poetry appears in *Collected Poems, 1931-1974* (1980).

**Dürrenmatt, Friedrich** (1921-1990), was a Swiss dramatist and novelist. Many of his plays are tragicomedies notable for their odd and arresting effects. His work shows a fascination with strange and paradoxical situations and characters. Dürrenmatt presented the world of his time in a state of decay and corruption. But some of his characters speak for his belief in courage and goodness. His best-known play is *The Visit* (1956).

Dürrenmatt also wrote *Romulus the Great* (1949), *The Marriage of Mr. Mississippi* (1952), *The Physicists* (1962), and *Play Strindberg* (1969). His works of fiction include *Traps* (1956) and *The Pledge* (1958). Dürrenmatt was born near Bern, Switzerland.

**D'Urville Island** lies at the eastern end of Tasman Bay, near the northern coast of the South Island of New Zealand. French Pass, a narrow strait, separates D'Urville Island from the South Island. D'Urville Island is about 29 kilometres long and 8 kilometres wide. It was named after the French explorer Jules Dumont D'Urville, who sighted it in 1827.

**Duryea** is the family name of two American brothers who were motorcar pioneers. Charles (1861-1938) and Frank (1869-1967) built the first successful petrol-driven car in the United States of America. Their one-cylinder model made a trial run in 1893 in Springfield, Massachusetts. The two brothers formed the Duryea Motor Wagon Company in 1895, and produced 13 cars in 1896. In 1898, Frank Duryea joined the Stevens Arms Company. There, he designed the four- and six-cylinder Stevens-Duryea cars. Charles was born in Canton, Illinois, and Frank in Washburn, Illinois.

**Duse, Eleonora** (1858-1924), an Italian actress, has been called "the greatest actress of her time." She seemed to live her parts instead of act them. Critics praised her natural and sincere acting.

Gabriele D'Annunzio wrote some of his best plays for her, including *La Gioconda* and *Francesca da Rimini* (see D'Annunzio, Gabriele). He fell in love with her and wrote a book, *The Flame of Life* (1900), based on their love story. Duse acted in Alexandre Dumas fils' *Camille* and in Henrik Ibsen's dramas *A Doll's House*, *Hedda Gabler*, and *The Lady from the Sea*. Her performances in these works established her reputation. Duse also acted in Giovanni Verga's tragedy *Cavalleria Rusticana*.

Duse was born on a train while her actor parents were travelling in Italy. She made her first public appearance at the age of 4. At 14, she played Juliet in *Romeo and Juliet*. She made several successful tours. **Dushanbe** (pop. 539,000) is the capital and largest city of Tajikistan. It lies in a cotton-growing valley at the foot of the Gissar range of the Tian Shan mountains (see Tajikistan [map]). Dushanbe is Tajikistan's scientific, cul-



tural, and educational centre. It is also the hub of much of the region's industry. Dushanbe's products include silk, textiles, processed foods, and machinery. Nearby hydroelectric plants supply power to the city and to metal and chemical plants close to it.

Three villages merged to form Dushanbe in 1926. When Tajikistan became a republic of the Soviet Union in 1929, Dushanbe was renamed Stalinabad after the Soviet dictator Joseph Stalin. In 1961, it was changed back to Dushanbe. Dushanbe became the capital of independent Tajikistan after the Soviet Union was dissolved in 1991. It was the scene of political unrest in 1992.

**Düsseldorf** (pop. 561,686) is a commercial and industrial city in Germany. It lies on the Rhine River (see Germany [political map]).

Düsseldorf has many beautiful buildings, parks, and gardens, and fashionable shops. Landmarks include St. Lambertus Church, a Gothic structure built in the 1200's; and the town hall, which dates from the 1500's. Düsseldorf is the home of a well-known art academy and a medical school. The city has a large harbour that is a base for important shipping and tourist cruise industries. Other industry includes banking, commerce, and the manufacture of chemicals, iron, and steel.

Düsseldorf was chartered as a city in 1288, though settlements existed on the city's present site as early as the 700's. Allied bombing raids during World War II (1939-1945) badly damaged many sections of the city. But the damaged areas were soon rebuilt.

**Dust** is made up of small particles of all kinds of solid matter. A speck of true dust is smaller than  $\frac{1}{1,000}$  of a millimetre. Coarser dust may be as large as  $\frac{5}{1,000}$  of a millimetre.

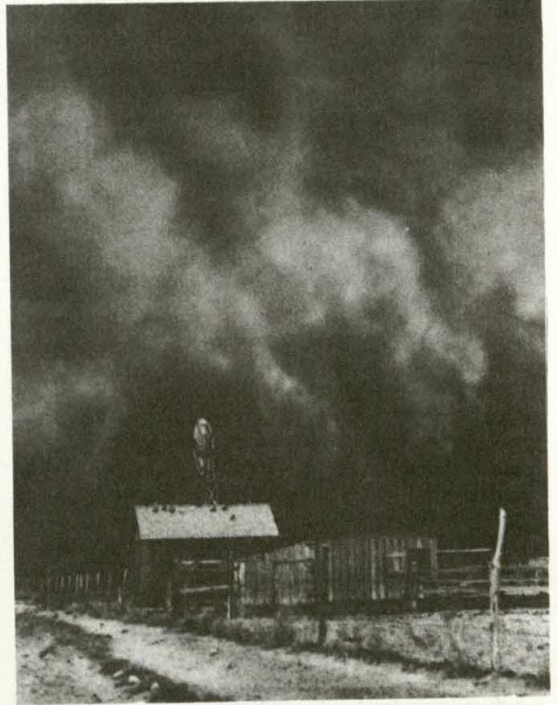
The greatest part of all ordinary dust in the atmosphere consists of mineral matter picked up by the wind. It comes from such places as bare soil, crumbling rock ledges, mud flats, and ploughed fields.

**Volcanic dust** is a special kind of dust that comes from volcanoes. Explosions of volcanoes change solid lava into powder and spray liquid lava into the air, forming tiny drops and shreds of glass. Volcanoes have spread large amounts of their dust over the earth.

**Dust deposits.** True dust is repeatedly picked up by the wind or washed into streams. Coarser dust settles rapidly. Two kinds of dust deposits cover hills and valleys. One is volcanic dust. The other is ordinary mineral dust blown from the bare mud flats that once lay in front of the great ice sheets covering North America and Europe. The rich soil called *loess*, found in Europe, Asia, and North America, is made of such dust deposits (see *Loess*).

**Importance to human beings.** Condensing water vapour settles on dust particles and forms water droplets. When these droplets unite with others, rain or snow may form (see *Rain*). Dust also may keep many of the sun's rays from reaching the earth.

Large amounts of mineral dust are always in the air of some quarries, mines, and factories. This dust may collect in workers' lungs and cause a disease called *silicosis* (see *Silicosis*). Dust also can serve as a carrier for disease bacteria. The spore stages of some disease bacteria can be thought of as dust particles themselves. The same is true of certain mould spores and the pollens which produce hay fever, asthma, and other allergies.



**Dust storms of the 1930's**, such as the one above, blew the powdery topsoil away in great clouds in the U.S.A. The droughts that contributed to the dust storms damaged crops in most of the Southwest and Great Plains, causing great hardship.

**Dust Bowl** refers to a series of destructive wind and dust storms that struck the United States during the 1930's. These storms ranked among the worst environmental disasters in world history. Most of the damage occurred from 1935 to 1938 in the southern Great Plains, and so this area also became known as the Dust Bowl. Altogether, the storms damaged about 20 million hectares of land, mainly in Colorado, Kansas, New Mexico, Oklahoma, and Texas. An additional 20 million hectares were endangered before conservation measures began to take effect.

The soil of the Dust Bowl had become dry and loose by the early 1930's. This occurred partly because much of the area's natural grassland was converted to wheatland during the early 1900's. But the wheat, as it was grown then, did not adequately protect the ground against winds. In addition, the remaining grasslands were destroyed through the grazing of too much livestock. A drought occurred from 1931 to 1938. During this time, the dry uncovered soil was easily eroded and blown when strong winds whipped through the region.

Dust storms had struck the Great Plains before, but they were never as large and destructive as those of the 1930's. One of the first major storms struck in May 1934. It carried about 318 million metric tons of dirt all the way to the East Coast. About 40 big storms swept through the Dust Bowl in 1935, with dust often reducing visibility to less than 1.5 kilometres.

Most of the storms came in the spring. At that time, the snow had melted, the winds were unusually strong,



and the new crops were not big enough to hold the soil. Many people and animals caught in the open during the storms had their lungs badly damaged or became lost. Soil had to be shovelled out of houses and away from barn doors. Cars and farm machines were ruined. The region's agricultural economy was wrecked as farmers could find little to harvest. One of the most dramatic results was the mass departure of thousands of bankrupt and discouraged farmers and their families, many of whom went to California to seek a better life. *The Grapes of Wrath*, a novel (1939) by John Steinbeck, describes the unhappy plight of many of these migrants.

The federal government sent aid to the Dust Bowl. The Soil Conservation Service, which was set up in 1935, taught farmers ways to slow down the process of erosion and protect the soil. In addition, more than 29,800 kilometres of trees were planted in small belts to break the force of the winds blowing across the plains. As the crisis passed, however, many farmers abandoned the protective methods. During droughts in the 1950's and 1970's, dust storms again damaged the region.

**Dust explosion** occurs when a cloud of burnable dust is ignited, causing an intense release of energy. Such explosions can damage property and kill people.

Explosive dust clouds can be produced by certain industrial operations. Common dusts that explode include those of cereal grains, coal, cocoa, cotton, pigment, sugar, and wood. Even metal dusts can explode.

A dust explosion begins with the ignition of a small group of dust particles in a concentrated dust cloud. These particles ignite nearby particles which, in turn, ignite others. The heat spreads until a fireball engulfs the entire cloud. The burning cloud produces large amounts of energy and expanding gas. If the exploding cloud is in a confined space, pressure builds rapidly, and the explosion can cause great damage.

**Dust storm** is a strong, turbulent wind that carries fine particles of clay, silt, and other earthy material for long distances. The particles are swept up and remain suspended in the air during a dust storm. Most of the particles measure less than  $\frac{1}{16}$  millimetre in diameter. Dust storms occur where the ground has little or no protective vegetation because of low rainfall, grazing, or poor farming practices. Dust storms play an important role in soil erosion. A dust storm may cover hundreds of kilometres and rise to a height of more than 300 metres. It carries as much as 875 metric tons of dust particles per cubic kilometre of air. Winds of at least 40 kilometres per hour are associated with dust storms.

Most dust storms occur in areas where wind erosion is strong and loose material is exposed. During the 1930's, parts of the American states of Colorado, Kansas, New Mexico, Oklahoma, and Texas were hit by dust storms caused by soil erosion. Today, dust storms occur in parts of northern Africa, Asia, and Europe.

See also **Dust Bowl**.

**Dusty, Slim** (1927- ), is the stage name of David Gordon Kirkpatrick, an Australian country and western singer. His most famous song, "Pub with No Beer," was released in 1957. It was the first Australian recording to appear on hit parades in the United Kingdom. Slim Dusty was born at Kempsey in New South Wales.

**Dutch.** See **Netherlands**.

**Dutch Antilles.** See **Netherlands Antilles**.

**Dutch East India Company** was a powerful trading company that helped establish Dutch rule in what is now Indonesia. In 1602, the Dutch government granted the company a monopoly on trade between Asia and the Netherlands. The company also received broad governmental and military powers, including the right to rule territories and to wage war in Asia.

By 1700, the company had gained control of the cinnamon, clove, and nutmeg trade in the East Indies. It had trading posts in many Asian countries and ruled parts of what are now South Africa and Sri Lanka and most of present-day Indonesia.

In the 1700's, the demand for textiles from India, tea from China, and coffee from Arabia and Java exceeded that for spices. The Dutch East India Company had strong competition from the English East India Company and other traders. The Dutch company lost money and was disbanded in 1799.

See also **East India Company**; **Indonesia (History)**; **Netherlands (History)**; **South Africa (History)**.

**Dutch East Indies.** See **Indonesia (History)**.

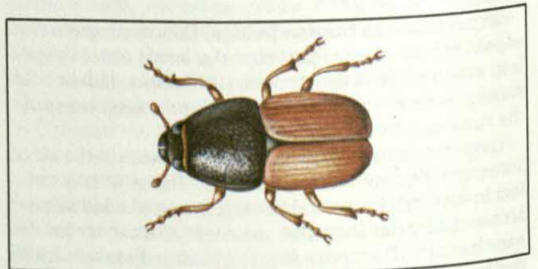
**Dutch elm disease** is a severe disease of the elm tree. It is caused by a fungus carried by the native elm bark beetle and the smaller European bark beetle. The disease can cause the death of a large elm in four to eight weeks.

Dutch elm disease usually begins with a wilting of the younger leaves in the upper part of the tree. Later, lower branches become infected. By midsummer, many of the leaves turn yellow and then brown, and they curl and drop off. Some of the leaves remain attached to twigs. When diseased branches are cut, long brown streaks can be seen beneath the bark.

The best way to control Dutch elm disease is to plant disease-resistant elms. But few varieties of elms are immune to all strains of the fungus. The use of insecticides that control the beetles helps limit the spread of the disease. Spraying the trees with fungicides is not very effective. Many cities and towns have regulations that require the removal of diseased trees.

Dutch elm disease is so called because the Dutch first observed it in the Netherlands in 1919. It reached Britain in the early 1920's, and the United States in 1930. It has since spread extensively. An epidemic of the disease occurred in Britain in the late 1960's and early 1970's, from infected wood thought to have been imported from the United States.

**Dutch explorers** played a major part in the early European exploration of Australia. Two Dutch sailors, Willem Jansz and Jan Lodewycksz, were probably the first



The European bark beetle is one of the two kinds of beetles that spread Dutch elm fungus disease from tree to tree.



Europeans to sight the continent. They sailed along the coast of Cape York Peninsula in 1606. In 1611, Hendrik Brouwer, a Dutch navigator, opened up a new route to the East Indies (now Indonesia). He sailed east from the Cape of Good Hope and then turned north. Many Dutch navigators passed the East Indies and, sailing too far east, landed in Australia. They included Dirk Hartog in 1616, Peter Nuyts in 1627, and François Pelsaert in 1629. Some ships were wrecked, including the *Gilt Dragon* in 1656. In 1697, William de Vlamingh explored the area where Perth now stands.

All those who saw the land described it as barren and unprofitable for trade. But Anthony Van Diemen, the governor of the Dutch East Indies, sent Abel Janszoon Tasman to explore the continent in 1642. Tasman brought back a great deal of geographical knowledge, but the Dutch authorities were unimpressed because he found no opportunities for trade. The great period of Dutch exploration around Australian waters ended with Tasman.

**Dutch Guiana.** See Suriname.

**Dutch language.** See Netherlands (People).

**Dutch oven** is a covered metal cooking pot. Modern Dutch ovens are usually made of aluminium. Previously they were made of cast-iron with a rimmed lid. The pot would be set on hot coals, and coals were also placed on the lid. Brick ovens in fireplaces and chimneys are sometimes called Dutch ovens.

**Dutch pins.** See Bowling (History).

**Dutch West India Company** was formed by Dutch merchants and chartered by the government of the Netherlands in 1621. The company was given trading and colonizing privileges for a period of 24 years in North America, the West Indies, and Africa. The colony of New Netherland included parts of what are now the American states of New York, New Jersey, Delaware, and Connecticut. The colony was founded by the Dutch West India Company and had headquarters in New Amsterdam (now New York City). See also New Netherland.

**Dutch West Indies.** See Netherlands Antilles.

**Du Toit, Alexander Logie** (1878-1948), was an outstanding South African geologist. His book, *The Geology of South Africa*, was published in 1926. It became a standard reference work on the subject. He also made a major contribution to the theory of *continental drift* (see Continental drift). *The Wandering Continent* (1937) showed that there were important links between the Karoo area in the southern part of South Africa, and similar places in South America, India, and Australia.

Du Toit was born in Cape Town. He studied mining engineering and geology in Scotland. In 1903, he returned to South Africa to join the Cape Geological Commission. Over a period of 15 years, he mapped in great detail the vast area of the Karoo. In 1918, he became chief geologist of the Department of Irrigation. In 1927, Du Toit became a consultant geologist in De Beers Consolidated Mines, a company producing diamonds.

**Duty**, in economics. See Customs; Tariff.

**Duvalier, François** (1907-1971), was the president of Haiti from 1957 until his death in 1971. Duvalier ruled as a dictator and allowed no one to oppose him. He was elected to a seven-year term as president in 1957. In 1961, before his term ended, he declared himself re-elected. He was elected president for life in 1964 by the

National Assembly, whose members he had himself selected.

Papa Doc, as Duvalier was nicknamed, was a doctor and an authority on voodoo, a kind of religion practised by most Haitians. He used the Haitian peasants' fear of voodoo to maintain his power (see Voodoo). Many Haitian peasants believed he had magical powers. Duvalier also controlled the armed forces and a feared secret police force that the people call the *Tontons Macoutes* (bogeymen).

Duvalier was born in Port-au-Prince, Haiti. He graduated from the National University of Haiti medical school in 1934. He was secretary of labour and public health in 1949 and 1950, and adviser to a public health commission from 1952 to 1954. After François Duvalier died, his son—Jean-Claude Duvalier, nicknamed Baby Doc—became president. Jean-Claude also ruled as a dictator. Rebels overthrew his government in 1986, and he fled from Haiti. See Haiti (History).

**Dvina River** is the name of two rivers in Eastern Europe. One, called the Western Dvina or Daugava, rises west of Moscow, in Russia, and flows into the Gulf of Riga at Riga, Latvia. This river is 1,019 kilometres long.

Another river, the Northern Dvina, is an important waterway in the northwestern part of Russia. The Northern Dvina, formed by the Sukhona and Vychegda rivers, is 732 kilometres long. It flows into the White Sea at the port of Arkhangelsk. Steamboats travel on the Northern Dvina. It is connected to the Neva and Volga rivers by the Northern Dvina Canal. For the location of both of the rivers, see Russia (terrain map).

**Dvořák, Antonín** (1841-1904), was a Czech composer. He and Bedřich Smetana are considered the founders of the Czech national school of music. Dvořák composed in a variety of musical forms, including songs, *chamber music* (compositions played by small groups), choral works, operas, symphonies, and dances. He is best known for his symphony *From the New World*. This symphony is a good example of the neoromantic music style of the late 1800's.

The folk music of the Czechs and other Slavic peoples was the main source of Dvořák's music. Dvořák's songs have passages of powerful dramatic expression and skilful use of melody. His best-known songs include *Moravian Duos* (1876), *Gypsy Melodies* (1880), and *Biblical Songs* (1894). His most famous chamber work is the piano trio *Dumky* (1891). The music in his chamber works, as well as in such orchestral works as the *Carnival* overture (1892), is lyrical and powerful. Dvořák's major choral works include the famous *Stabat Mater* (1876), composed after the death of two of his children; and the oratorio *St. Ludmila* (1886). *Rusalka* (*The Water-Nymph*, 1900) is the best of his several operas.

Dvořák was born in Nelahozeves, a small village near Prague. At the age of 16, he went to Prague to study music. The Czech National Theatre was founded in 1862, and Dvořák became a viola player in its orchestra. Dvořák began composing at about the same time. He was his own greatest critic, and, in 1873, he burned the scores of most of the works he had composed.

A performance of the cantata *Hymnus* in 1873 marked the first public performance of a Dvořák work. The work received great acclaim. Dvořák soon applied for a *stipend* (grant) offered to musicians by the government. He



submitted the score of a symphony to support his application. The judges, including Johannes Brahms, were so impressed by the power of Dvořák's music that they granted him a three-year stipend. This occasion also saw the beginning of a lifelong friendship with Brahms, who used his influence to help get Dvořák's compositions published.

In 1878, Dvořák composed the first set of his well-known *Slavonic Dances*. A performance of it in 1879 in London made Dvořák known in England. Beginning in 1884, Dvořák visited England many times to conduct performances of his orchestral and his choral works.

In 1891, Dvořák became professor of musical composition at the Prague Conservatory. His growing fame and the success of his works in the United States brought him an offer to serve as director of the National Conservatory of Music in New York City. Dvořák held this position from 1892 to 1895. At the same time, he conducted, and visited Czech and other Slavic settlements in the Midwest. See *Iowa*.

Dvořák composed *From the New World* while living in the United States. The work was his ninth and last symphony. But it is usually referred to as his fifth symphony, because he started numbering his symphonies only after 1880. Dvořák made use of Negro spiritual melodies in his last symphony. He never used folk song melodies note for note but transformed them, preserving their spirit.

**Dwarf** is an unusually small adult human being, animal, or plant. Human dwarfs who have normal body proportions are also called *midgets*. Other human dwarfs have abnormal proportions. There are several kinds of dwarf animals, including dwarf cattle and toy dogs. Dwarf plants include ornamental fruit trees and several varieties of flowers, such as marigolds and dahlias.

Dwarfism occurs both in individual organisms and in entire groups of organisms. Such groups include African Pygmies, Shetland ponies, and dwarf trees. Dwarfism may result from an inherited defect or from problems that affect a developing baby during pregnancy. A wide variety of diseases, very poor nutrition, or severe emotional deprivation also can interfere with growth.

This article discusses human dwarfism, which occurs as the result of an underdeveloped skeleton. The growth of the bony skeleton depends on the formation of tissue called *cartilage* (see **Cartilage; Bone** [Development of bones]). Dwarfism results when the cartilage cells do not grow and divide properly. Such improper development may occur because of defective cartilage cells or interference with the growth of otherwise normal cartilage cells. Defective cartilage cells cause *chondrodystrophic dwarfism*, in which the defect is restricted to the cartilage cells, or *chromosome-related dwarfism*, in which there is a more widespread cellular disorder. Interference with the growth of normal cartilage cells results in either *hormonal dwarfism* or *nonhormonal dwarfism*.

**Chondrodystrophic dwarfism** occurs when only certain cartilage cells are defective. The term *chondrodystrophic* means *badly developed cartilage*. Most chondrodystrophic dwarfs have abnormal body proportions. The defective cells occur only in the spine or only in the arms and legs. Consequently, either the *torso* (chest and abdomen) or the limbs grow unusually short.

**Chromosome-related dwarfism** results when all the cells of the body are defective. Such defects involve a disturbance in the number of *chromosomes* per cell. The chromosomes are the cell structures that contain *genes*. Genes provide the cell with information on how to grow and divide. Each body cell normally has 46 chromosomes. If a cell has an extra chromosome or is missing a part of a chromosome or a whole chromosome, growth may be affected. One such disorder that results in dwarfism is *Turner's syndrome*.

**Hormonal dwarfism** may occur when a hormone deficiency interferes with the growth of normal cartilage cells. Hormones are chemical substances secreted by various glands. These substances circulate through the blood and influence cells to act in certain ways.

There are three major hormones or hormonelike substances needed for growth: (1) *growth-hormone-releasing hormone* (GHRH) from the *hypothalamus*, a hormone-producing centre in the brain; (2) *growth hormone* (GH) from the pituitary gland; and (3) *somatomedin C*, produced by the liver and probably other tissues, including bone and cartilage. GHRH stimulates the pituitary gland to release GH. GH probably stimulates growth in some cells, but more importantly, it stimulates release of somatomedin C. Somatomedin C can acceler-



**Dwarfism** occurs when the bones' cartilage cells do not grow properly. As a result, such body parts as the arms, legs, and torso may be underdeveloped. This photo shows a dwarf and his doctor, who is of normal height.



ate growth in many types of cells. Extreme emotional neglect or abuse produces a reversible form of dwarfism probably by interfering with one or more of these hormones through effects on the nervous system. Other hormones, including *insulin* from the pancreas and *thyroxine* from the thyroid gland, also influence growth.

Someone deficient in any of the major growth-promoting hormones is usually normally proportioned but much shorter than other members of the family. Such individuals appear much younger than their actual age and grow at a slower rate than normal. They reach final height, and may become sexually mature in their mid-20's.

Doctors use GH to stimulate growth in some patients with subnormal growth. In the past, GH was extracted from human pituitary glands. Today, it is made in the laboratory by genetic engineering methods.

**Nonhormonal dwarfism** occurs if disease or severely impaired nourishment blunts the growth of cartilage cells. For example, diseases of the bowel or kidneys may interfere with growth. Many nonhormonal and hormonal interferences with growth can be corrected, with rapid "catch-up" growth taking place after treatment. A child who appears to be growing too slowly should be examined by a doctor to determine whether the child's growth is normal.

See also **Bonsai**; **Pygmies**; **Shetland pony**; **Toy dog**. **Dwarf star.** See **Star** (The size of stars; diagram).

**Dwight, John** (1635?-1703), was an important early English potter. He developed and manufactured high-quality stoneware at his factory in Fulham, now a London suburb. The stoneware he produced led to the establishment of England as a world centre for ceramics production.

Dwight was probably born in Oxfordshire. He settled in Fulham between 1671 and 1673. Dwight took out his first patent for stoneware in 1671. The patent was renewed in 1684 for a hard red stoneware that was a great improvement over earlier English ceramics. Dwight improved his stoneware to the point that he was able to use it to make sculptures. These sculptures included small figures of mythological characters and full-sized portrait heads. The heads marked the peak of English ceramic art in the late 1600's.

**Dwyfor** (pop. 28,600) is a local government district in Gwynedd, Wales. Most of its people speak Welsh. Agriculture and tourism are the main industries of the district, which includes the Llyn Peninsula and part of the Snowdonia National Park. Sheep graze on the hills and dairy farming is important in the lowlands. Aberdaron, Criccieth, and Pwllheli are among the holiday centres. Pwllheli is also a market town and the district's administrative centre. Porthmadog is a business centre. See also **Gwynedd**.

**Dyaks** are a group of people most of whom live in Sarawak, eastern Malaysia. The name is also spelled *Dayaks*. There are two groups of Dyaks—the *Ibans*, also called *Sea Dyaks*, and the *Land Dyaks*. The approximately 350,000 Ibans make up about 31 per cent of Sarawak's population. They live along the seacoast and rivers. Land Dyaks live inland and call themselves by the name of their village or locality.

Most Dyaks wear traditional clothing—sarongs for women and brightly coloured *loincloths* (cloth wrapped

around the hips) for men. However, many Dyaks have adopted Western dress.

Most Dyaks live in bamboo houses called *long houses*, which are built on poles. The floors are from 2 to 4.5 metres above the ground. Long houses measure from 9 to 300 metres long. As many as 50 families may live in one long house, each in a separate room. See **Indonesia** (picture: A Dyak long house).

Most Dyaks are farmers or plantation workers, and their major crop is rice. Some teach or hold civil service or factory jobs. Others are skilled boat makers or weavers. Most Dyaks follow traditional religions. Some are Christians or Muslims.



**Dyaks** are a Southeast Asian people who mainly live in eastern Malaysia. The group shown above are Ibans, or Sea Dyaks, who live along rivers. Many earn their living by making boats.

**Dye** is a chemical compound used to produce long-lasting colours in materials. The textile industry uses dyes to colour fibres, yarns, and fabrics. Manufacturers also dye food, fur, ink, leather, paper, plastics, and wood. This article discusses textile dyeing.

Until the 1850's, all dyes were made from natural sources, such as various parts of plants or of certain animals. During the late 1800's and early 1900's, chemists developed synthetic dyes. These dyes hold their colour better and cost less to produce than natural dyes. Today, industry uses synthetic dyes almost entirely.

### How dyes work

A dye must be dissolved before it can work. When textiles are placed into a *dye bath* (dye solution), the fibres absorb the molecules of the dye. These molecules give the fibres the desired colour.

Dyed textiles vary in their ability to hold colour. However, all textiles can be made *colourfast* to at least some extent. A colourfast fabric does not change colour under normal use. For example, a fabric is *lightfast* if it does not fade in sunlight. It is also *washfast* if it keeps its colour after being laundered. Such substances as chlorine bleach and perspiration may also affect the colours of fabrics. Many dyes resist colour changes from such substances.

To improve the colourfastness of some fabrics, dyers



add substances called *mordants* to dyebaths. Mordants combine with the dye molecules and fix them firmly in the fibres. The chief mordants include tannic acid and soluble compounds of such metals as aluminium, chromium, copper, iron, and tin.

### Kinds of dyes

**Synthetic dyes.** The chief kinds of synthetic dyes include (1) acid dyes, (2) azoic or developed dyes, (3) basic dyes, (4) direct dyes, (5) disperse dyes, (6) premetallized dyes, (7) reactive dyes, (8) sulphur dyes, and (9) vat dyes. Pigments are sometimes used to colour textiles. But pigments do not dissolve, and so they are not considered to be true dyes. Manufacturers use adhesives to fix pigments to fibres.

**Acid dyes** are dissolved in acid solutions. These dyes give bright colours to nylon, silk, and wool.

**Azoic or developed dyes** involve a reaction of two colourless chemicals to produce a deeply coloured dye in the fibre. This chemical reaction increases brightness and wash-fastness in fabrics made of acrylic, cotton, nylon, and rayon.

**Basic dyes** are dissolved in alkaline solutions. They provide many brilliant colours and are used on acrylic, wool, and other fibres.

**Direct dyes** colour fibres without the help of a mordant, though salt is used to help achieve deep shades. Dyers use these dyes on such fibres as cotton and rayon.

**Disperse dyes** dissolve only slightly in water. Dyeing at high temperatures helps dissolve the insoluble dye particles, allowing them to be absorbed into the fibres. Disperse dyes colour acetate, acrylic, nylon, and polyester.

**Premetallized dyes** contain such metals as copper and chromium, which improve colourfastness. Such dyes are widely used on acrylic, nylon, and wool.

**Reactive dyes** form a strong chemical bond with certain fibres, including cotton, nylon, rayon, and wool. These dyes produce bright, washfast colours.

**Sulphur dyes** and **vat dyes** are insoluble in water and are dissolved in an alkaline solution. Fibres coloured with such dyes also receive an oxygen treatment to help fix the dyes. Vat dyes rank among the most colourfast dyes. Dyers use sulphur dyes and vat dyes chiefly on cotton and rayon.

**Natural dyes.** Most natural dyes came from such parts of plants as the bark, berries, flowers, leaves, and roots. The madder plant, which grows in Asia and Europe, supplied bright red dyes for many fabrics, including linen and silk. People in many countries obtained *saffron*, a yellow dye, from the crocus plant. They used saffron on such textiles as silk and wool. Natural *indigo*, a dark blue dye, comes from the indigo plant, which grows chiefly in India. Dyers used it on cotton, wool, and other fibres, and it is still used on denim fabrics. *Logwood* is another natural dye that is still used. It comes from a tree that grows in Central America, Mexico, and the West Indies. Logwood supplies black and brown dyes for such materials as cotton, fur, and silk. *Henna*, an orange-brown dye made from a shrub of North Africa and the Middle East, was used to colour leather. Henna is sometimes used to dye human hair.

Leading animal dyes included *carmine* and *Tyrian purple*. Carmine, a bright red dye, was made from the

dried bodies of an insect of Mexico and Central America. Tyrian purple was a rare dye that came from certain shellfish of the Aegean and Mediterranean seas.

### Dyeing textile materials

Textiles are dyed at various stages. If textile fibres are dyed before being spun into yarn, the process is called *stock dyeing*. In *yarn dyeing*, or *skein dyeing*, the fibres are dyed after they are made into yarn. Most stock and yarn dyeing takes place in large vats.

In *piece dyeing*, manufacturers apply the dyes after the yarn is made into cloth. Piece dyeing is used for most solid-colour fabrics. Some dyeing machines pull the cloth through the dyebath. Others have squeeze rolls that force dye into the cloth. Some machines can continuously dye 90 metres of fabric per minute.

Manufacturers print designs on some fabrics. A machine applies different colours to various areas by means of screens or engraved rolls. These areas form a pattern. The process is known as silk-screen printing. See *Silk-screen printing*; *Textile*.

### History

People have dyed fabrics and other materials for more than 5,000 years. Dyers have also used mordants for several thousand years.

In 1856, an English chemist named William Perkin discovered the first synthetic dye accidentally. This dye, called *mauve*, is pale purple. Perkin produced mauve when he tried to make quinine from a coal tar product called aniline.

Before World War I (1914-1918), Germany made most of the world's dyes. During the war, the Germans cut off their supply of dyes. As a result, the dye industry grew rapidly in other parts of the world. Since the 1940's, chemists have invented many synthetic textile fibres—and have developed thousands of synthetic dyes to combine with them.

#### Related articles in World Book include:

Batik	Indigo	Madder	Saffron
Catechu	Lake (dye)	Mauve	Stain
Coal tar	Leather (Final processing)	Mordant	Tie dyeing
Colour		Phoenicia	
Henna	Logwood	(Trade)	

**Dyer, Bob** (1909-1984), began his long-running quiz show, "Pick-a-Box," on Australian radio in 1941. From 1956 until he retired in 1971, Dyer continued the programme on television. Robert Neal Dyer was born in Nashville, Tennessee in the United States. He went to Australia in 1937 and worked as a hillbilly singer. He and his wife, Dolly, a former dancer and photographic model, both set world records for big-game fishing. **Dyfed** was the largest county in Wales. It ceased to exist as a local government area in April 1996. Many of Dyfed's people are very Welsh in their customs and way of life. Dyfed was situated in southwest Wales and included the Welsh cultural and educational centre of Aberystwyth. The region has some industrial centres near its south coast, but it is mainly an agricultural area.

The county of Dyfed was created in 1974, when the local government of Wales was reorganized. Previously, the area had consisted of the three counties of Cardiganshire, Carmarthenshire, and Pembrokeshire. Dyfed was the name of an old Welsh kingdom.





**Forestry** is an important and developing industry in Dyfed, especially in the northern part of the region. Most of the trees cut for timber are evergreen trees.

### People and government

**Language.** Welsh is spoken by about half of the region's people. In the rural areas, about three-quarters of the people speak Welsh in addition to English. Some secondary schools have been established teaching subjects in Welsh.

Southern Dyfed around Pembroke is very English in use of language and in way of life. The area is known as *Little England beyond Wales*.

**Customs.** Many old farming customs have disappeared, but some, such as sheep-shearing parties, are still popular. Religious customs, too, have diminished in importance. But in the central parts of Dyfed, *y gymanfa bwn* is popular. This is an annual meeting of Nonconformist churchgoers to chant passages of scripture and sing hymns.

**Recreation.** Rugby Union is the most popular organized sport. The main towns have soccer teams. Boating is popular, and cricket is played in the south.

**Local government.** Dyfed included the local government districts of *Carmarthen*; *Ceredigion*, which included Aberystwyth, Cardigan, and Lampeter; *Dinefwr*, which included Ammanford, Llandeilo, and Llandovery; *Llanelli*; *Preseli Pembrokeshire*, which included Fishguard, Haverfordwest, and Milford Haven; and *South Pembrokeshire*. In April 1996, the county and districts were abolished, and replaced with unitary authorities, each having all local government powers within its own area.

The Dyfed-Powys Police serve both Dyfed and the neighbouring county of Powys. Their headquarters are at Carmarthen. The Crown Court meets at Carmarthen and Haverfordwest.

### Facts in brief about Dyfed

**Largest towns:** Llanelli, Pembroke, Milford Haven, Carmarthen, Aberystwyth.

**Area:** 5,765 km<sup>2</sup>

**Population:** 1991 census—341,600.

**Chief products:** *Agriculture*—beef, lamb, milk and dairy products, potatoes, timber. *Manufacturing*—clothing, furniture, oil products, plastics, steel goods, tin plate.

### Economy

**Agriculture** is the most important single industry in Dyfed. Dairy farming is widespread in the central parts of the area. Dyfed produces more than half of the milk produced in Wales. There is much mixed farming in the river valleys and coastal plains. Farmers in the mountainous parts of the region raise sheep and cattle. Crops include barley, oats, and wheat. Farmers in the south specialize in producing early potatoes.

Forestry is an expanding industry in the moorland and upland areas. In northern Dyfed, large areas are planted with evergreen trees. Fishing, once a large industry based at Milford Haven, has declined. Fishing for salmon from *coracles* (tiny boats) still goes on near Cardigan and Carmarthen.

**Manufacturing.** Llanelli has traditionally been a centre of the tin plate industry, in which steel is coated with tin in a special large mill. Tin plate works have now declined, but Llanelli still has many general engineering factories, some of which still service the steel industry. Products made in Llanelli now include bathroom and household ware; beer; chemicals, plastics and rubber products; copper wire and cables; motorcars and vehi-



**Dyfed**, in Wales, is bordered by the Bristol Channel and the Irish Sea. The region is mountainous in the east and west.



cle components; piano and organ keyboards; and women's underwear.

Milford Haven has long been one of the United Kingdom's major centres of oil refining. Its natural harbour can accommodate very large oil tankers. During the 1970's, the oil refineries and related industries at Milford Haven expanded rapidly.

**Tourism** is a rapidly growing industry in Dyfed. About 270 kilometres of Dyfed's coastline form the Pembrokeshire Coast National Park.

**Transportation and communication.** Fishguard is the terminus for the main railway line from London. It is a port for passenger travel to Rosslare in Ireland. Another ferry for Rosslare operates from Pembroke. The only steam-operated line of British Rail is the picturesque Vale of Rheidol railway, which links Aberystwyth with Devil's Bridge. Weekly newspapers are published in Dyfed's largest towns.

### Land

**Location and size.** Dyfed has borders with Gwynedd, Powys, and West Glamorgan. Its coasts are bounded by the Bristol Channel and the Irish Sea. Its maximum north-south and east-west dimensions are about 110 kilometres.



**The Rebecca Riots** began in Dyfed. A memorial tablet to the rioters is at Efailwen, to the north of Narberth.

**Land features.** The Preseli Mountains in western Dyfed rise to about 540 metres. Archaeologists believe that this area was the source of some of the stones used at Stonehenge (see **Stonehenge**). In the east are the Black Mountains. The Brecon Beacons National Park covers the Black Mountains and extends into Dyfed.

The county's highest peak, Pumlumon Fawr, which reaches 752 metres, is in the Cambrian Mountains in the northeast. Southern Dyfed is a wide lowland. The main rivers, the Teifi, Tywi, and Ystwyth, rise in the Cambrian Mountains.

**Climate.** Dyfed's climate is mild. For example, St. Ann's Head near Milford Haven has average temperatures of 6° C in January and 14° C in August. Further inland, especially on the higher ground, there are more extreme temperatures. Annual rainfall in the southern lowlands and coastal fringe is less than 1,000 millimetres. On the western slopes of Pumlumon Fawr, rainfall averages more than 1,500 millimetres.

### History

Dyfed has many prehistoric remains. The Romans built a fortress at *Moridunum* (Carmarthen), but did not establish a permanent form of government in the area.

Christianity came to Dyfed during Roman times. St. David, the patron saint of Wales, founded St. David's in the A.D. 500's. Throughout medieval times, St. David's was a centre of pilgrimage to the shrine of the saint.

The Normans conquered the area in the early 1100's. They set up a *county palatine*—an almost independent area—around Pembroke. The Normans built a magnificent castle at Pembroke. They encouraged English people to settle in the area. These policies developed the strongly English community, still present today.

The counties of Cardiganshire, Carmarthenshire, and Pembrokeshire evolved during Norman times. They gained legal status in the Acts of Union of 1536 and 1542. These acts united Wales with England.

During the Napoleonic Wars, French soldiers landed at Fishguard and occupied the area for a short time.

The early 1800's were hard times for southwestern Wales. As a result, disturbances started in 1839. Bands of men dressed as women attacked toll booths which collected money from road users. The disturbances, which continued until 1844, were called the Rebecca Riots.

**Related articles in *World Book* include:**

Glamorgan	Powys
Gwynedd	United Kingdom, History of
Kings and queens of Britain and	the
Ireland	Wales (History)

**Dyke.** See **Irrigation** (Surface irrigation; picture: Flood irrigation); **Netherlands** (introduction; pictures).

**Dylan, Bob** (1941- ), an American composer, singer, and musician, was the most influential folk-song writer of the early 1960's. His early songs often protested against what many people considered the wrongs of society. These protest songs include "Blowin' in the Wind" (1962) and "The Times They Are A-Changin'" (1963). Dylan's biggest hit was "Like a Rolling Stone" (1965).

Dylan was born in Duluth, Minnesota. His given and family name was Robert Allen Zimmerman. In 1961, he moved to New York City to meet his idol, folk singer Woody Guthrie.

Early in his career, Dylan accompanied himself on



acoustic guitar and harmonica. In the mid-1960's, he formed a rock band that used electric guitars. Dylan has shifted musical direction several times. In the late 1960's and early 1970's, he moved toward country music. In the late 1970's, he wrote music with a Christian message. He continued to influence songwriters in the 1980's, making music that mixed spiritual and nonreligious themes.



Bob Dylan

**Dynamics**, in physics, is the study of objects that change their speed or the direction of their motion because of forces acting upon them. Sir Isaac Newton expressed the relationship of these forces and changes in motion in his second law of motion. This law states that the force applied to an object is equal to the mass of that object multiplied by its acceleration in the direction of the force (see **Force** [Measuring force]; **Motion** [Newton's laws of motion]). See also **Mechanics**; **Statics**.

**Dynamics, Group.** See **Group dynamics**.

**Dynamite** is one of the most important industrial explosives. It is used to blast out damsites, canal beds, mines, quarries, and the foundations for large buildings. It also has been used for demolition in warfare.

The principal explosive in dynamite is an oily liquid called *nitroglycerin*. It is mixed with other materials—some explosive and some nonexplosive—and packed in cylinders made of waxed paper or plastics. These cylinders, called *cartridges*, range from 22 to 200 millimetres in diameter and from 10 to 76 centimetres in length.

To use dynamite, workers insert an explosive device called a *detonating cap* or *blasting cap* into one end of the cartridge. They place the cartridge in a hole bored into the material to be blasted. Earth is packed around and behind the cartridge. After moving to safety, the workers set off the detonating cap—and the explosion—by means of a fuse or an electric current.

**Kinds of dynamite.** There are four chief varieties of dynamite: (1) *straight dynamite*, (2) *ammonia dynamite*, (3) *straight gelatin*, and (4) *ammonia gelatin*.

Straight dynamite contains nitroglycerin and an absorbent, chemically reactive mixture, such as wood pulp and sodium nitrate. Straight dynamite is the oldest type of dynamite and has been replaced by ammonia dynamite for most uses.

Ammonia dynamite is stronger, safer, and cheaper than straight dynamite. It contains ammonium nitrate and produces fewer toxic fumes and cooler gases than other dynamites do. It is called a *permissible explosive*, which means that it can be used safely in mines where extreme heat could ignite dust or gas in the air.

Straight gelatin is made from a stiff gel called *blasting gelatin*. Blasting gelatin consists of nitroglycerin mixed with a small amount of an explosive called *guncotton* (see **Guncotton**). Sodium nitrate and other ingredients are added to make straight gelatin. Straight gelatin has been replaced by ammonia gelatin for most uses.

Ammonia gelatin is made by adding ammonium nitrate and other ingredients to blasting gelatin. Ammonia



**Dynamite** has many industrial uses. This silver miner is placing cartridges of the explosive in holes drilled in the mine.

gelatin is waterproof. It is used for underwater blasting.

**History.** Dynamite was invented in 1867 by Alfred Nobel, a Swedish chemist and the founder of the Nobel Prizes. Nobel discovered that *kieselguhr*, a type of chalky earth, absorbed a great deal of nitroglycerin. He found that kieselguhr soaked with nitroglycerin could serve as an explosive that was much less dangerous to handle than pure nitroglycerin. It also was much more powerful than the gunpowder explosives then used for blasting. From his discovery, Nobel developed straight dynamite and blasting gelatin.

In the early 1900's, ammonia dynamite and ammonia gelatin were developed. During the mid-1900's, many blasting operators began to use a mixture of ammonium nitrate and fuel oil, called ANFO, instead of dynamite. They also used *slurry explosives*. Slurry explosives are slushy mixtures of chemicals called *nitrocarbonitrates*. ANFO and slurry explosives are cheaper to use than dynamite but need dynamite or other explosives to detonate them.

See also **Explosive**; **Fuse**; **Nitroglycerin**; **Nobel, Alfred B.**; **TNT**.

**Dynamo.** See **Electric generator**.

**Dynamotor** is an electric machine that can be used as both a motor and a generator. It can change a direct current (DC) from high to lower voltage, or from low to higher voltage. Transformers can handle only alternating current (AC). The dynamotor might be called a direct-current transformer. Its armature has two windings, and each winding can be used as either a motor winding or a generator winding. Dynamotors are seldom used today. Most have been replaced by electronic *DC to DC converters*. These devices convert the input DC to AC, raise or lower the AC voltage using some form of transformer, and then convert the AC voltage to output DC voltage.

**Dyne** is a unit of force. A dyne is defined as the force that acting upon 1 gram of matter, will give it an acceleration of 1 centimetre per second for every second the force acts (1 centimetre per second per second). The dyne is part of the centimetre-gram-second (CGS) system, an early version of the metric system of measure-



ment. In the present metric system, called the International System of Units (SI), the *newton* is used instead of the dyne to measure force (see *Newton*; *Measurement*).

**Dysentery** is a disease involving inflammation of the lining of the large intestine. The inflammation, which is caused by microscopic organisms, produces abdominal pain and diarrhoea. The bowel movements may contain mucus and blood. Some cases of dysentery involve fever or vomiting.

Diarrhoea causes people with dysentery to lose fluids and salts necessary to their bodies. The disease can be fatal if the body becomes dehydrated.

Dysentery strikes people of all ages throughout the world, but some forms of the disease occur more frequently in tropical countries. It can be particularly dangerous to infants, the elderly, and people in weak physical condition.

**Causes and symptoms.** Dysentery is caused by several types of microorganisms, including *salmonella* bacteria, *shigella* bacteria, and single-celled animals called *amoebas*. *Shigella* and *amoebas* cause most dysentery. *Shigella* produce *shigellosis*, also called *bacillary dysentery*. *Shigellosis* begins suddenly and involves high fever and severe diarrhoea. If untreated, the disease may disappear in a few weeks. However, some cases result in fatal dehydration.

*Amoebas* cause *amoebic dysentery*, which begins gradually and rarely produces high fever. It can cause diarrhoea for years, however, and may produce *ulcers* (open sores) in the large intestine. The infection may spread to the liver. *Amoebic dysentery* seldom is fatal.

**Spread.** The organisms that cause dysentery are transmitted through the *faeces* (solid body wastes) of infected individuals. Some people, known as *carriers*, spread the disease but have no symptoms of it.

The bacteria and *amoebas* enter the body through the mouth, in most cases in food or water. Flies and unwashed hands can transfer *faeces* to food. Fruit and vegetables must be thoroughly washed if they have been treated with fertilizer containing human *faeces*.

Epidemics of dysentery have occurred where people live in overcrowded conditions and have poor sanitation. In the past, the disease was common in hospitals, prisons, and army camps. During some wars, more soldiers died from dysentery than in battle. Improved sanitation during the 1900's has greatly reduced the number of cases of dysentery. However, epidemics of the disease still occur in developing countries.

**Diagnosis and treatment.** Doctors diagnose dysentery after finding *shigella* or *amoebas* in samples of the patient's *faeces* or intestinal tissues. Treatment includes replacing fluids and body salts that the patient has lost. Doctors also use certain antibiotics to speed recovery from dysentery.

**Dyslexia** is a term that refers to many reading disabilities. Originally, the term referred only to those disabilities thought to be the result of a disorder in the central nervous system. However, many people began to use the term to describe a broad range of reading problems, and even spelling and writing problems. Thus, *dyslexia* came to mean simply *poor reading* to many people.

Research indicates that dyslexia may be caused by abnormal development of the baby's brain during the

mother's pregnancy. The abnormalities interfere with the brain's ability to understand written material. For example, dyslexics reverse words and letters, so that they read *was* for *saw* or *d* for *p* or *b*. Many such people also have difficulty remembering the sequence of letters in a word and in distinguishing right from left. Some dyslexic children suffer from muscular coordination problems.

Before a child is diagnosed as dyslexic, other more specific possible causes of the reading problem should be ruled out. These possibilities include limited intelligence; poor eyesight or hearing; immaturity in emotional, intellectual, or physical development; inappropriate teaching; or unstable home conditions.

Special tests are used to detect dyslexia, but some authorities question their value. In fact, many learning experts doubt that dyslexia actually exists. They argue that a diagnosis of dyslexia lumps together various problems that cause poor reading. These specialists maintain that the problems should be specifically identified for each poor reader. In this way, a person can be given the most appropriate treatment or training. The treatment of dyslexic children may include physiotherapy, occupational therapy, and speech therapy.

**Dyson, Sir George** (1883-1964), was a British composer, teacher, and writer. He is best remembered for his cantatas *Quo Vadis* and *The Canterbury Pilgrims*. These works show his gift for vocal writing. In one of his books, *The New Music*, he showed great understanding of the trends in music of the 1900's.

Dyson was born at Halifax, in West Yorkshire, and studied at the Royal College of Music, in London. From 1937 to 1952, he was director of his old college. He then became president of the Royal College of Organists. He was knighted in 1951.

**Dyspepsia** is a term which is loosely used to refer to a disorder in digestion. Dyspepsia involves such symptoms as pain in the upper abdomen, heartburn, belching, fullness and heaviness in the stomach region, and spitting up food or sour-tasting liquid. Dyspepsia may be caused by ulcers of the stomach or duodenum, hyperacidity, cancer of the stomach, gallstones, infection of the gall bladder, colitis, constipation, adhesions, chronic appendicitis, and worry and nervousness. It can be treated only by treating the disorder which is causing it. In many cases, proper diet is part of the treatment.

See also *Indigestion*.

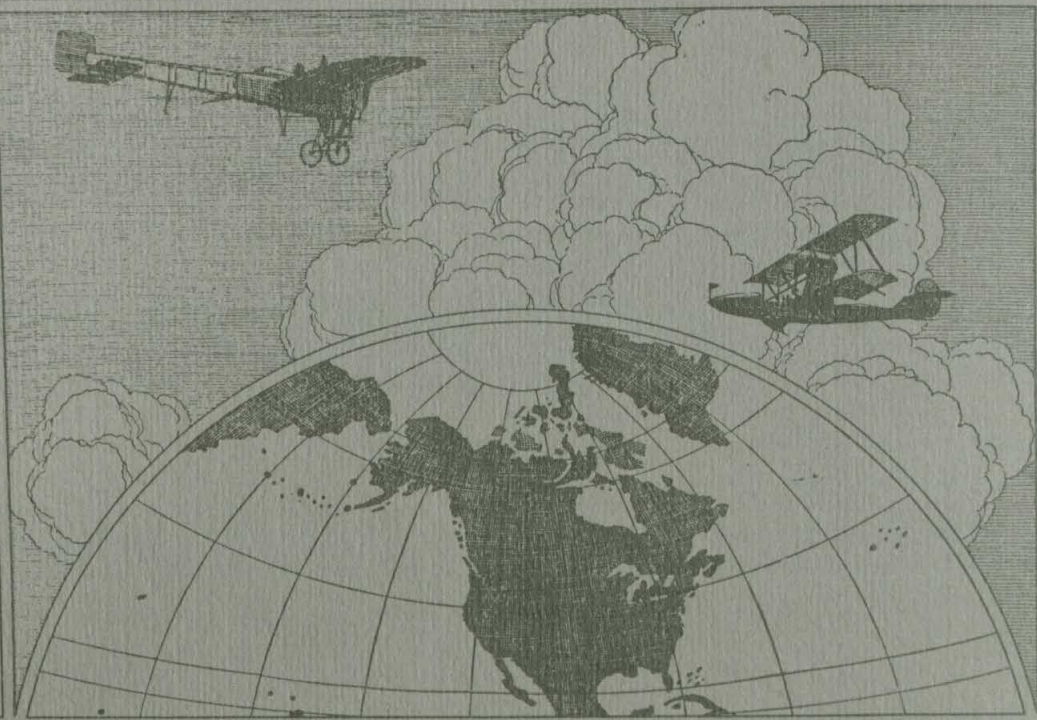
**Dysprosium**, a chemical element with symbol Dy, is one of the rare-earth metals. Its atomic number is 66, and its atomic weight is 162.50. Its density is 8.559 grams per cubic centimetre at 25° C (see *Density*). It has a melting point of 1412° C and a boiling point of 2567° C. The name comes from the Greek word *dysprositos*, meaning *hard to get*.

French scientist Paul Émile Lecoq de Boisbaudran discovered dysprosium in 1886. It is found associated with erbium, holmium, and other rare earth metals in the minerals gadolinite, euxenite, xenotime, and others. Dysprosium is best separated from the other rare earth metals by solvent extraction or ion-exchange processes (see *Ion*). When cooled to low temperatures, it is strongly attracted by a magnet.

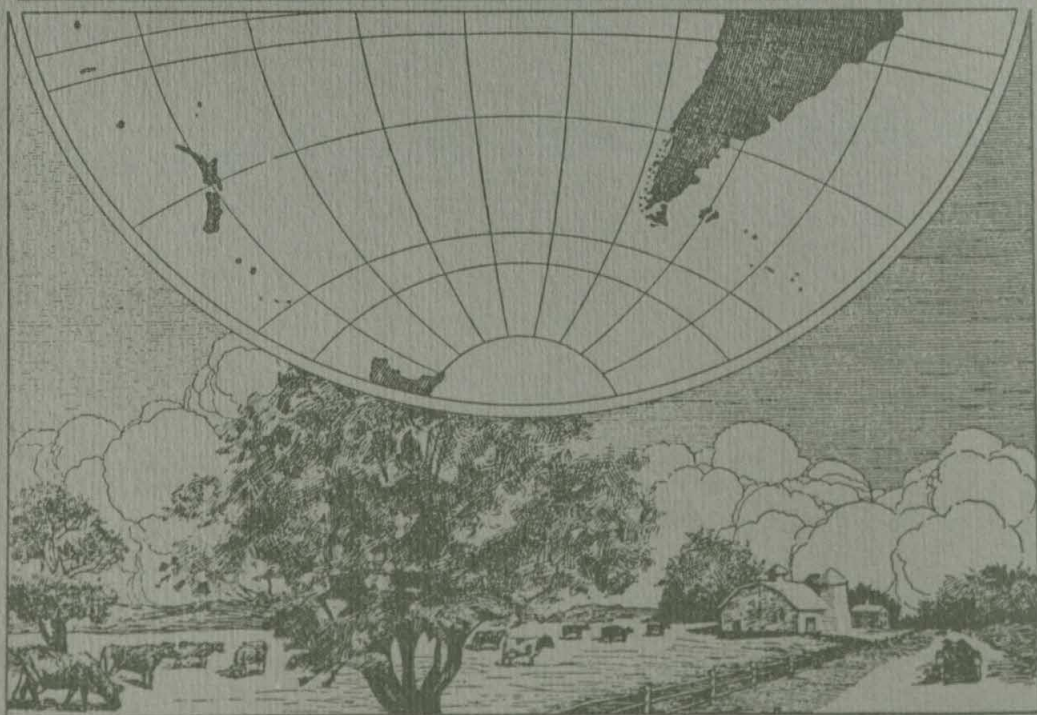
See also *Rare earth*.

**Dystrophy, Muscular.** See *Muscular dystrophy*.

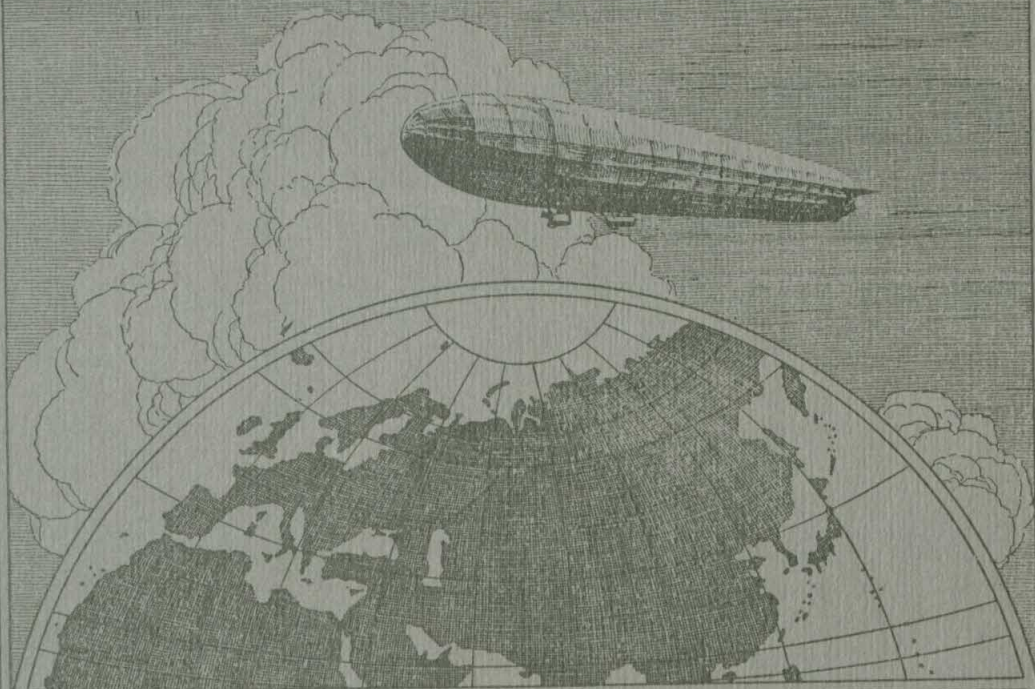




# THE WORLD BOOK







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